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Street food: assessment of scientific relevance and characterization  
of street food offer of a sample in Maputo, Mozambique

Sofia Azevedo de Sousa

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UNIVERSIDADE DO PORTO

# Street food: assessment of scientific relevance and characterization of street food offer of a sample in Maputo, Mozambique

Sofia Azevedo de Sousa

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Faculdade de Ciências da Universidade do Porto e Faculdade de  
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Mestrado em Ciências do Consumo e Nutrição

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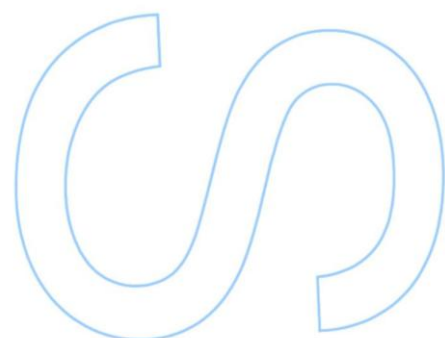
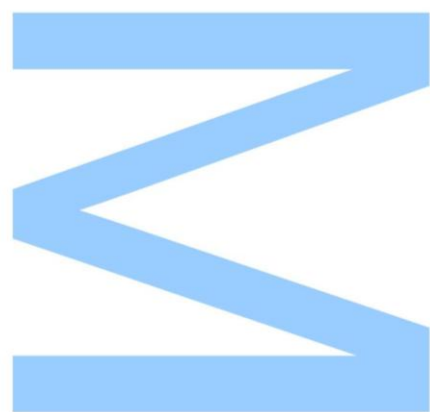
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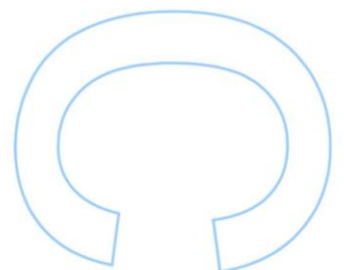
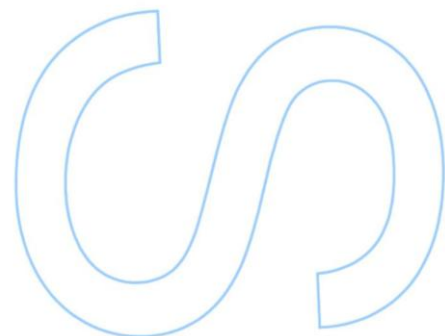
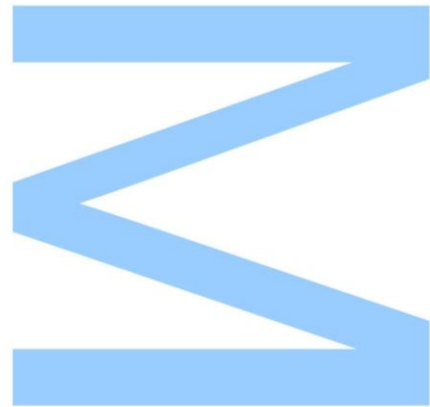


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Todas as correções determinadas  
pelo júri, e só essas, foram efetuadas.

O Presidente do Júri,

Porto, \_\_\_\_/\_\_\_\_/\_\_\_\_



*“Never give up on a dream just because of the time it will take to accomplish it. The time will pass anyway.”*

— Earl Nightingale

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## Resumo

Os países em desenvolvimento, entre os quais se encontra Moçambique, estão atualmente sob transformações demográficas, económicas e sociais, devido à crescente urbanização, industrialização e desenvolvimento económico. A transição nutricional é uma das mais marcadas transformações nos países em desenvolvimento, e envolve a ocidentalização dos hábitos alimentares. O consumo de alimentos não processados ou minimamente processados diminui, enquanto a ingestão de alimentos altamente processados aumenta, dando origem a um padrão alimentar pobre em micronutrientes e fibra e rico em gorduras saturadas e *trans*, açúcares e sal. Estas alterações de consumo alimentar estão intimamente relacionadas com um aumento da prevalência de obesidade e outras doenças não comunicáveis relacionadas com a alimentação, substituindo gradualmente as doenças infecciosas como principais causas de morbilidade e mortalidade nos países em desenvolvimento, num processo designado transição epidemiológica. Devido à urbanização, o tempo dedicado à confecção e preparação de refeições em casa tem vindo a diminuir drasticamente. A comida de rua fornece alternativas acessíveis, convenientes, saborosas e de baixo custo, tornando-se uma opção cada vez mais popular para as refeições diárias da população urbana. O consumo de comida de rua tem vindo a aumentar a nível mundial, apresentando uma contribuição significativa para a alimentação diária de muitos habitantes em áreas urbanas de países em desenvolvimento. No entanto, atualmente ainda existem poucos estudos publicados internacionalmente sobre disponibilidade, consumo e/ou composição nutricional de comida de rua em países em desenvolvimento.

O objetivo principal deste trabalho é aumentar o conhecimento acerca da comida de rua, a sua relevância na literatura internacional e a sua caracterização em Maputo, Moçambique. Este trabalho tem como objetivos específicos: caracterizar a oferta de comida de rua em Maputo; avaliar a composição nutricional da comida de rua mais frequentemente disponível em Maputo; classificar os produtos alimentares vendidos nas ruas de Maputo quanto à extensão do seu processamento; e colaborar numa *scoping review*

dos artigos publicados na literatura internacional sobre comida de rua. Com este propósito, foi realizado um estudo transversal de uma amostra de 968 locais de venda de comida de rua, identificados no distrito de KaMpfumu, Maputo (artigo I), uma *scoping review* que analisou 345 artigos originais publicados em revistas científicas sobre comida de rua (artigo II), e um ensaio onde a comida de rua vendida nos locais de venda identificados no artigo I foi classificada de acordo com a extensão do seu processamento (resultados preliminares).

Resultados do artigo I mostram que a comida de rua apresenta uma elevada diversidade, com a coexistência de produtos alimentares altamente processados com alimentos naturais e minimamente processados. Tendo em conta alimentos excepto fruta e bebidas, os alimentos industriais estão mais frequentemente disponíveis, relativamente aos caseiros. Os alimentos analisados bromatologicamente apresentam excessivas quantidades de sódio, existindo em média uma predominância de hidratos de carbono e lípidos comparativamente às proteínas. De acordo com os resultados preliminares, os alimentos e bebidas classificados como *in natura* ou minimamente processados são os mais frequentemente disponíveis nos locais de venda de comida de rua identificados, seguidos dos classificados como ultra-processados. Resultados do artigo II mostram que o número de publicações sobre comida de rua em revistas científicas tem vindo aumentar nos últimos anos, sendo que a maioria aborda questões de segurança alimentar e é realizada em países em desenvolvimento. Por outro lado, estudo sobre disponibilidade, consumo e valor nutricional da comida de rua são escassos.

Os resultados desta tese mostram que a oferta de comida de rua em Maputo, Moçambique está gradualmente a aproximar-se do padrão alimentar ocidental. Esta realidade juntamente com a atual lacuna de investigação no que concerne à disponibilidade, consumo e composição nutricional da comida de rua em áreas urbanas de países em desenvolvimento, reforça a necessidade de uma maior investigação acerca destas matérias, com o objetivo de promover políticas de saúde orientadas para a melhoria dos produtos alimentares disponíveis na rua.

**Palavras-chave:** comida de rua, comida pronto-a-comer, hábitos alimentares, urbanização, transição nutricional, transição epidemiológica, disponibilidade alimentar, composição nutricional, análise bromatológica, processamento alimentar, *scoping review*, Moçambique, Maputo.



# Abstract

Developing countries, such as Mozambique, are currently under demographic, economic and social transformations, due to the growing urbanization, industrialization and economic development. Nutrition transition is one of the most marked transformations in developing countries, involving the westernization of the food habits. The consumption of non-processed or minimally processed foods decreases, whereas the intake of highly processed foods rises, resulting in a food pattern that is low in micronutrients and fiber, and rich in saturated and *trans* fats, sugars and salt. These changes in food consumption are closely related to an increase in the prevalence of obesity and other diet-related non-communicable diseases, gradually replacing infectious diseases as the main causes of morbidity and mortality in developing countries, in a process called epidemiological transition. Due to urbanization, time dedicated to cooking and preparation of meals at home has been declining drastically. Street food provides accessible, convenient, tasteful and inexpensive alternatives, becoming an increasingly popular option to everyday meals amongst urban dwellers. Street food consumption has been increasing worldwide, with a significant contribution to the daily food intake of many urban dwellers in developing countries. However, currently there is still few internationally published studies focused on street food availability, consumption and/or nutritional composition in developing countries.

The main objective of this work is to increase the knowledge about street food, its relevance in the international literature and its characterization in Maputo, Mozambique. The specific objectives of this work are: to assess the street food offer in Maputo; to evaluate the nutritional composition of the most frequent street foods in Maputo; to classify street foods offered in Maputo, according to its processing extension; and to collaborate in a scoping review of internationally published articles about street food. With this purpose, it was conducted a transversal study of a sample of 968 street food vending sites, identified in the district of KaMpfumu, Maputo (article I), a scoping review in which 345 original research articles addressing street food were analysed (article II), and an essay where street food sold in the vending sites identified in

article I was classified according to the extension of its processing (preliminary results).

Results from article I show that street food presents high diversity, with coexistence of highly processed food products with natural and minimally processed foods. Regarding foods except fruit and beverages, industrial foods were the most frequently available, compared to home-made foods. The foods from bromatological analysis present excessive amounts of sodium, with a predominance on average of carbohydrates and fats compared to proteins. According to the preliminary results, foods and beverages classified as *in natura* or minimally processed are the most frequently available in the street food vending sites indentified, followed by ultra-processed foods. Results from article II show that the number of publications in scientific journals addressing street food has been rising in recent years, the majority of them approaching matters of food safety and being conducted in developing countries. On the other hand, studies on street food availability, consumption and nutritional value are scarce.

The results from this thesis show that street food offer in Maputo, Mozambique is gradually approaching to the occidental food pattern. This reality, along with the current research gap concerning street food availability, consumption and nutritional composition in urban areas of developing countries, reinforces the need for a thorough investigation regarding this matters, aiming at promoting health policies targeted to the improvement of the food products sold on the street.

**Keywords:** street food, ready-to-eat-food, food habits, urbanization, nutrition transition, epidemiological transition, food availability, nutritional composition, bromatological analysis, food processing, scoping review, Mozambique, Maputo.

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## List of Abbreviations

FAO - Food and Agriculture Organization

g - grams

GBD - Global Burden of Diseases

IHME - Institute of Health Metrics and Evaluation

kcal - kilocalorie

kg - kilograms

NCDs - non-communicable diseases

RDA - Recommended Daily Allowance

UN - United Nations

WHO - World Health Organization

# 1. Theoretical Framework

## 1.1. Urbanization: a global process

Global urbanization is one of the most important trends of the 21<sup>st</sup> century. According to data from the United Nations (UN), globally, urban population has grown from 746 million in 1950 to 3.9 billion in 2014. In 1950, 70% of the world's population lived in rural areas, and less than one third (30%) was classified as urban population. In 2014, more than one half of people worldwide (54%) was residing in urban areas, and by 2050, two-thirds (66%) of the world's population is projected to be urban(UN 2015a).

This phenomenon is occurring worldwide, and not only limited to the most urbanized regions. In fact, all regions are expected to continue urbanizing over the future decades, but Africa and Asia are currently the continents where this process is faster, together concentrating nearly 90% of the projected world's urban population growth between 2014 and 2050. Africa's urban population is projected to increase from the current value of 40% to 56% by 2050(UN 2015a).

Within the African continent, Mozambique is one of the countries where urbanization is most evident. The percentage of urban population increased from 3,5% in 1950 to 32% in 2014, and is estimated to rise further to 49,1% till 2050. In Maputo, capital of Mozambique, the number of people living in urban agglomerations grew from 92.000 in 1950 to 1.187.000 in 2015, and is predicted to reach 1.893.000 urban inhabitants by 2030(UN 2015a).

## 1.2. The evolution of developing countries: demographic, nutritional and epidemiological transitions

### 1.2.1. Demographic transition

As a consequence of urbanization, progressive industrialization and rapid economic growth, developing countries are currently undergoing a series of profound transformations. Due to socioeconomic development, which carries an increase in income and education, developing countries are gradually moving towards a context of population growth, with decreasing fertility and mortality and increasing life expectancy(Lee 2003, Bongaarts 2009).

According to data from the UN, in the less developed regions (comprising all regions of Africa, Asia (except Japan), Latin America and the Caribbean plus Melanesia, Micronesia and Polynesia) total population increased from 1.7 billion in 1950 to practically 6.1 billion in 2015, numbers that are expected to rise to 8.4 billion by 2050. Total fertility decreased from

6.08 children per woman in 1950-1955 to 2.51 in 2010-2015, being expected to further reduce to 2.25 in 2045-2050. Mortality also declined, from 23.2 deaths per 1000 population in 1950-1955 to 7.4 in 2010-2015. Life expectancy at birth increased from 41.5 years in 1950-1955 to 68.75 in 2010-2015, and is estimated to continue rising to 76.01 in 2045-2050(UN 2015b).

The same situation is occurring in Mozambique. The Mozambican population has grown from 6 million to almost 28 million between 1950 and 2015, and it is expected to achieve more than 65 million by 2050. Fertility declined from 6.60 children per woman in 1950-1955 to 5.45 in 2010-2015, and it is expected to lower to 3.39 in 2045-2050. It was also observed a reduction in mortality, with 32.8 deaths per 1000 population in 1950-1955 to 11.8 in 2010-2015. Life expectancy at birth increased from 31.28 years in 1950-1955 to 54.63 in 2010-2015, and is estimated to continue rising to 68.78 in 2045-2050(UN 2015b). The evolution of the demographic profile of Mozambique is presented in **Figures 1 and 2**. Figure 1 shows that population growth is common to all age groups and to both sexes. In figure 2, it is observable the abovementioned transformations in fertility, mortality and life expectancy, showing that Mozambique is shifting in accordance with the rest of the African continent.

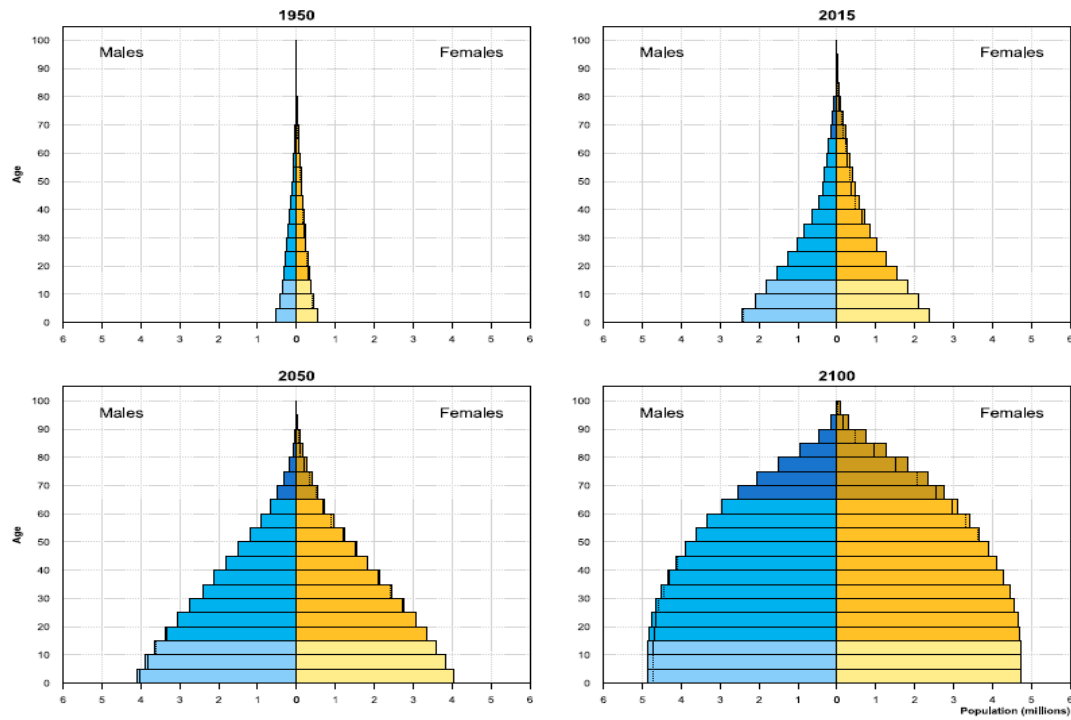
### 1.2.2. Nutrition transition

The concept of nutrition transition can be defined as "large shifts in diet and activity patterns, especially their structure and overall composition"(Popkin 2006), as a result of socio-economic development, urbanization and acculturation(Vorster, Kruger et al. 2011). According to the nutrition transition model proposed by Popkin et al., this phenomenon can be divided into five stages or patterns, according to nutritional, economic and demographic profiles, and also food processing: (1) *Collecting food*; (2) *Famine*; (3) *Receding famine*; (4) *Degenerative disease*; and (5) *Behavioral change* (Popkin 2006) .

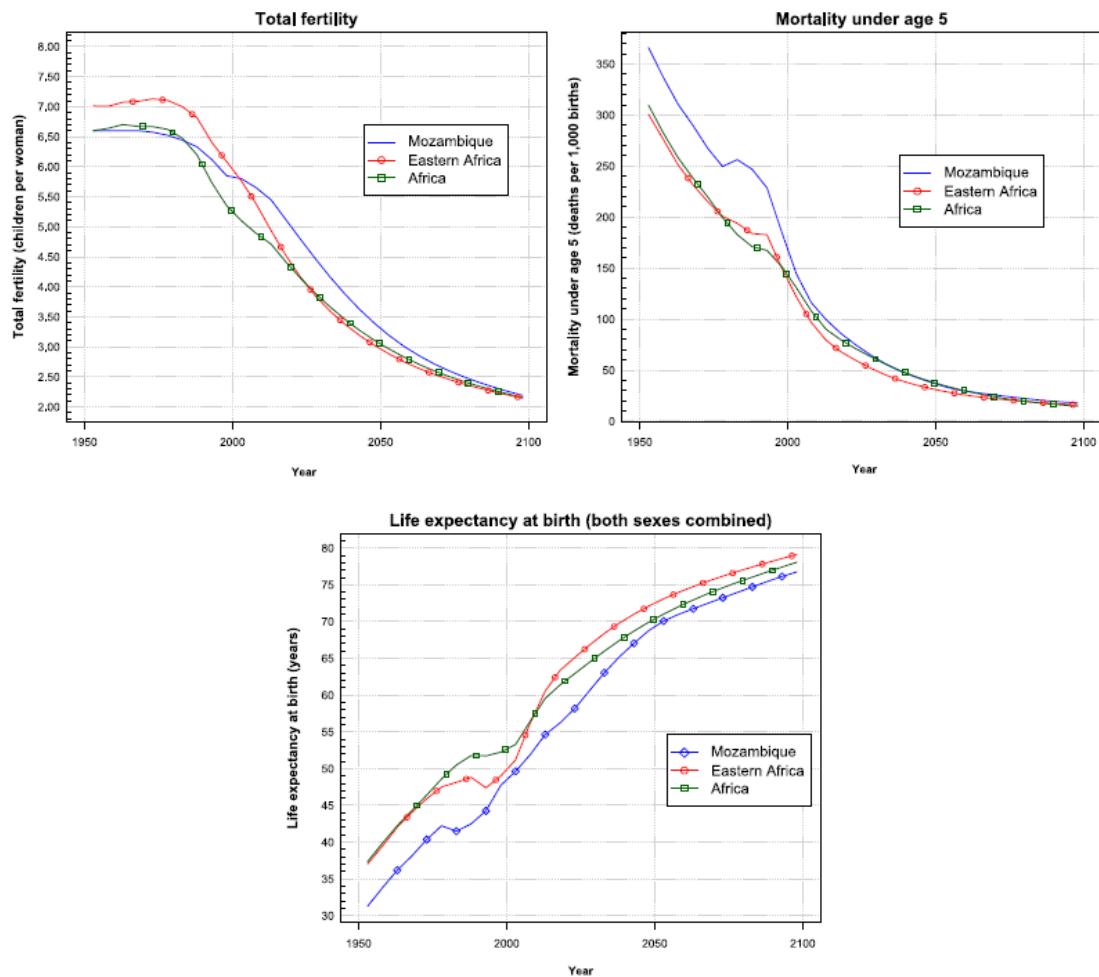
An evolution into a much more occidental food consumption pattern is now occurring in developing countries, in a phenomenon commonly known as the "westernization" of food habits(Popkin 2006), involving a number of dietary changes. These include decreases in the consumption of staple foods rich in starch and dietary fiber, plant protein sources such as legumes, as well as increasing ingestion of foods from animal origin rich in total fat and saturated fatty acids, energy-dense snack foods, carbonated sweetened beverages, alcoholic drinks, and added sugars and fats in culinary preparations(Vorster, Kruger et al. 2011).



**Figure 1.** Population (millions) of Mozambique, by age and group sex, from 1950 to 2100. (Source: United Nations, 2015b).



**Figure 2.** Total fertility, mortality under age 5 and life expectancy at birth in Mozambique, Eastern Africa and Africa, from 1950 to 2100 (Source: United Nations, 2015b).



Among urban societies, time dedicated to cooking at home has been declining drastically (Popkin 2011). This, along with dietary acculturation and globalisation, leads to increased consumption of food away from home, as well as a greater ingestion of convenience foods, commonly known as "take-away foods" (Nnyepi, Gwisai et al. 2015). Regarding food processing, the consumption of unprocessed or minimally processed foods, which are rich in micronutrients and fiber, is continually declining. On the other hand, the intake of highly-processed foods, much more likely to be energy dense and rich in fat (specially saturated and *trans* fat), refined carbohydrates, simple sugars and salt, tends to increase (Popkin 2011, Vorster, Kruger et al. 2011, Nnyepi, Gwisai et al. 2015).

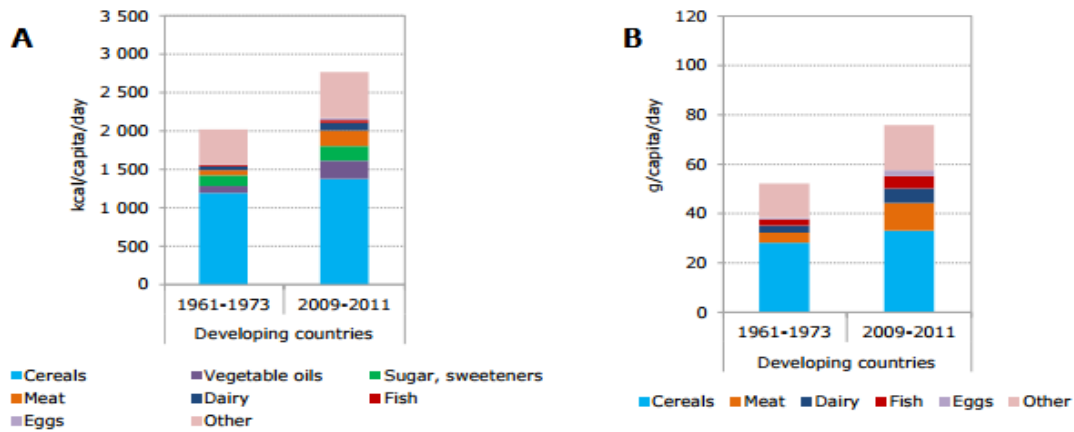
Physical activity patterns are changing as well, with several interconnected transformations occurring simultaneously, upon a much lower level of activity at work, transportation and leisure activities. In urban areas, it is being observed a shift away from high-energy expenditure occupations (e.g. farming, fishery) towards much more sedentary professional activities (e.g. service sector). The development of the transport sector and the expansion of the mass media is resulting in reduced energy expenditures regarding transportation and leisure time (Popkin and Gordon-Larsen 2004).

One of the least studied modifications with major consequences on food consumption and physical activity patterns is the expansion of the modern mass media in the low- and middle-income populations (BBC 2004). In developing countries, modern media has been penetrating into the quotidian of all urban dwellers, as it has been observed an increase in the ownership of television sets, cell phones and computers (Popkin 2011). Urbanization, followed by this mass of modifications in lifestyle and dietary behaviours, has been seized by the fast-food industry, as they provide quick, accessible and cheap take-away meals. Marketing is expanding and improving, with greater access to modern mass media and distribution infrastructures. The increasing number of large supermarkets, which are controlled by multinational corporations, leads to a greater access to foreign suppliers (Hawkes 2006, Kearney 2010), resulting in the globalization of food consumption patterns (Kearney 2010). However, there is still little research on the potential consequences that those alterations can bring to food intake and health in the developing world.

Data from the European Commission shows that total food supply has been gradually rising in developing countries, from 2022 kcal/capita/day in 1961-1973 to 2767 in 2009-2011, the same happening to protein consumption, which increased from 52 to 76g/capita/day during the same time periods (EU 2015). Per capita energy and protein availability of different food groups in developing countries is presented in **Figure 3**. A diversification of the diet is observable, as all food groups show growing availability, specially vegetable oils, animal

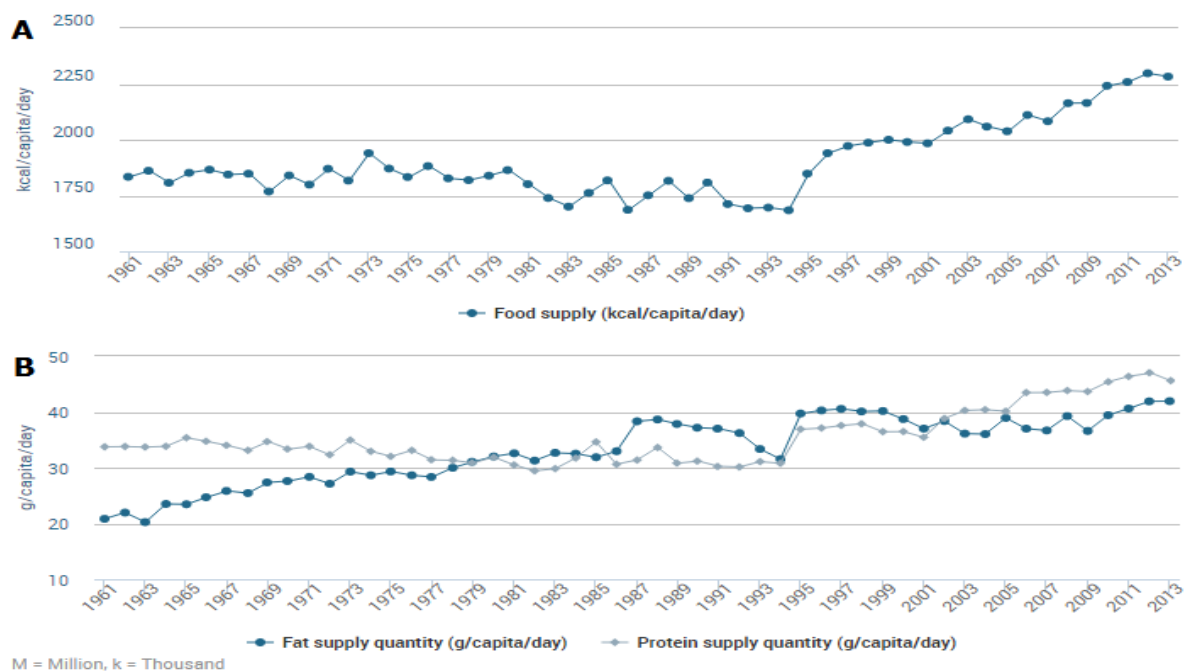
protein sources (meat, fish, dairy and eggs), sugars and sweeteners. However, in more recent years cereal intake is stagnating and even declining (EC 2015).

**Figure 3.** Per capita energy (A) and protein (B) availability in developing countries, between 1961-1973 and 2009-2011 (Source: European Commission, 2015).



Mozambique is currently undergoing the same changes regarding food consumption patterns. Data from the Mozambican food balance sheets between 1961 and 2013 show that total food supply increased from 1834 to 2283 kcal/capita/day, the same happening to protein (33.73 to 45.70 g/capita/day) and fat (20.82 to 41.92 g/capita/day) (**Figure 4**). Considering food groups, over the same time period it is observable an uprising availability of sugar and sweeteners, vegetable oils and animal protein sources like meat and fish/seafood; and simultaneously a decrease in staple foods rich in starch and dietary fiber such as starchy roots and vegetables other than tomatoes and onions (FAOSTAT 2015) (**Table 1**).

**Figure 4.** Per capita energy (A), protein and fat (B) availability in Mozambique, between 1961 and 2013 (Source: FAOSTAT, 2015).



**Table 1.** Mozambican per capita supply (kg/year and kcal/day) of selected food groups in 1961 and 2013 (*Source: FAOSTAT, 2015*).

Food Groups	Per capita supply 1961		Per capita supply 2013	
	kg/year	kcal/day	kg/year	kcal/day
Starchy roots	292.23	873	265.82	773
Sugar and sweeteners	6.63	64	11.22	109
Vegetable oils	2.73	66	8.73	211
Vegetables (other than tomatoes and onions)	17.2	11	18.59	12
Meat	4.96	29	8.5	67
Fish/seafood	3.99	8	8.06	14

### 1.2.3. Epidemiological transition

Epidemiological transition can be described as a group of long-term shifts in mortality and disease patterns, closely associated with the demographic and socioeconomic transitions, where infectious diseases are gradually being replaced by chronic diseases as principal causes of morbidity and mortality. This theory was originally postulated by Abdel Omran in 1971(Omran 2005).

Nutrition transition, which decades ago began to emerge only in developed regions, is now occurring throughout the developing world, at a faster rate and with a much lower economic level than in industrialized countries(Vorster, Kruger et al. 2011), having serious implications in the rapid rise of obesity and other diet-related non-communicable diseases (NCDs) worldwide(Hawkes 2006, Popkin 2011). This phenomenon also contributes significantly to an excessive ingestion of empty calories at the expense of health(Nnyepi, Gwisai et al. 2015), further deepening the problem of nutritional deficiencies in the urban areas of South Africa, where the intakes of micronutrients (especially calcium, iron, zinc and some vitamins) often don't reach recommended values(ASSAf 2007, Vorster, Kruger et al. 2011).

A higher caloric intake (cities offer an increased number of energy-dense food options) combined with a lower energy expenditure (because of more sedentary urban jobs, transportation means and leisure activities) create an energy imbalance, which is likely to result in a gradual weight gain(Kearney 2010). Those poor-quality energy-dense diets are associated with an enhanced prevalence of overweight and obesity, as well as its related co-morbidities, including type II diabetes, cardiovascular diseases and many types of cancer, leading to further morbidity and mortality, as well as substantially increased health care costs(Hawkes 2006, Guh, Zhang et al. 2009, Kearney 2010, WHO 2014).

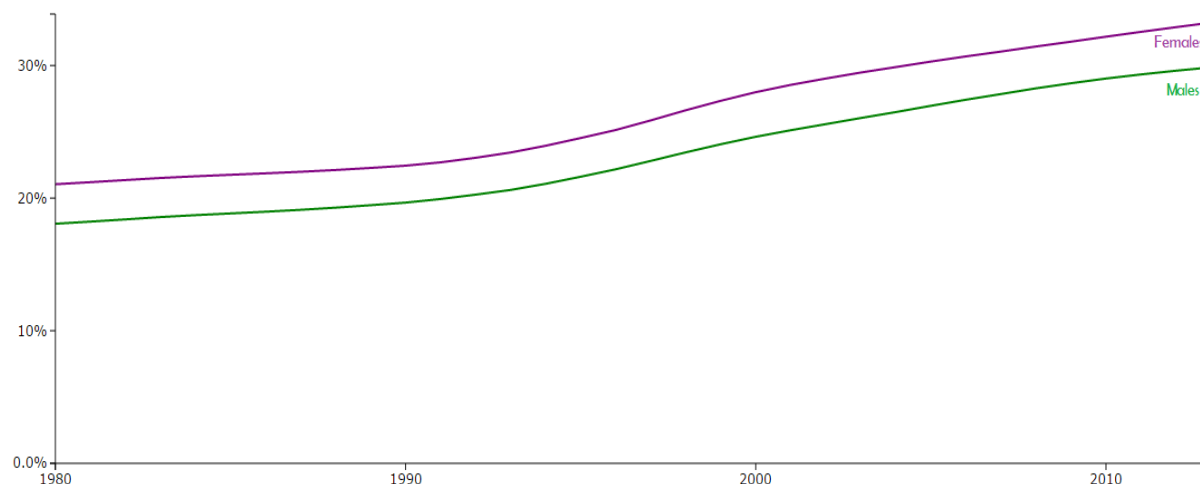
### 1.2.3.1. Overweight and Obesity

The World Health Organization (WHO) defines overweight and obesity as an "abnormal or excessive fat accumulation that presents a risk to health", expressed by values of Body Mass Index greater than  $25\text{kg/m}^2$  or  $30\text{kg/m}^2$ , respectively (WHO 2015a, WHO 2015b). The prevalence of overweight and obesity have increased across the globe, and with it has come a large growth in nutrition-related NCDs (Popkin 2011). The worldwide prevalence of obesity more than doubled since 1980. In 2014, 39% of adults aged 18 years or older were overweight, and 13% were obese (WHO 2015b).

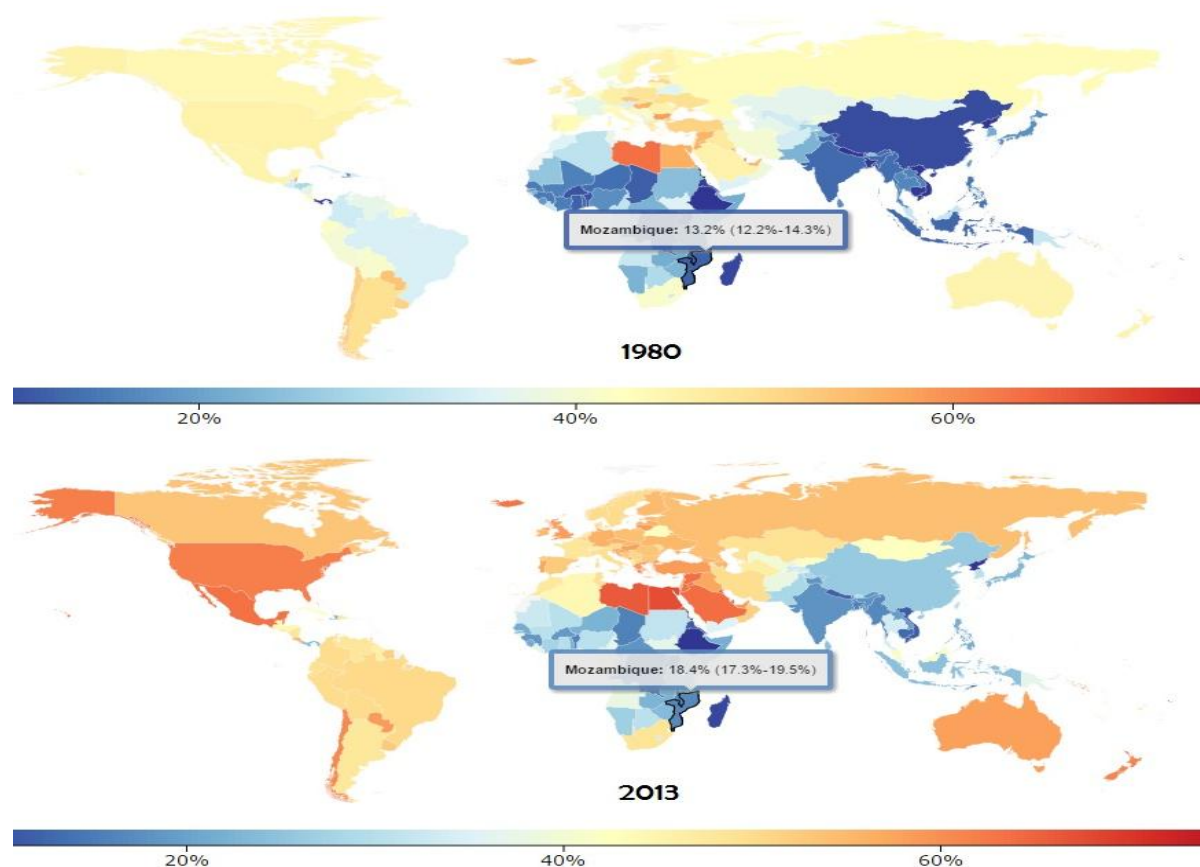
Overweight and obesity has not always been a significant concern in developing countries. Undernutrition, on the other hand, has been and still continues to be an important problem in some of those countries (Nnyepi, Gwisai et al. 2015). In recent decades, however, the prevalence of overweight and obesity has been high and rising in developing countries (Walker, Adam et al. 2001), mostly due to the nutrition transition, together with the decreasing in physical activity (Popkin and Gordon-Larsen 2004, Vorster, Kruger et al. 2011). Data from the Institute of Health Metrics and Evaluation (IHME) of the Global Burden of Diseases (GBD) shows that the developing world suffered an increase in the prevalence of overweight and obesity of approximately 10%, between 1980 and 2013, for both men and women (**Figure 5**) (IHME 2015a). Particularly in Mozambique, the prevalence of overweight and obesity has increased from 13.2% in 1980 to 18.4% in 2013 (**Figure 6**), this rise being observed in all ages groups of the Mozambican population (**Figure 7**) (IHME 2015a). Also, this condition affects the female gender more: the prevalence of overweight is 26.5% for Mozambican women older than 20 years, versus 14.1% for men within the same age range (Ng, Fleming et al. 2014). Also, the prevalence of overweight was higher than underweight among urban women, a pattern already described in other countries under epidemiological transition (Gomes, Damasceno et al. 2010).

With the broadly well documented rise in the prevalence of overweight and obesity in South Africa, it is expected that the prevalence of NCDs should be increasing as well. As a result, many countries in Africa are now facing a double burden of nutrition-related diseases, with under- and over-nutrition being co-existing in the same population (Hawkes 2006, Kearney 2010, Vorster, Kruger et al. 2011).

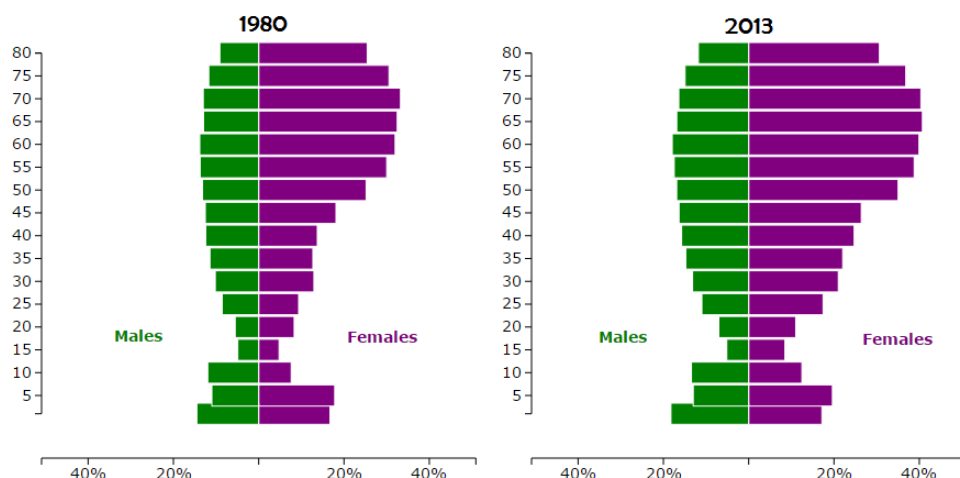
**Figure 5.** Prevalence of overweight and obesity in developing countries, for both sexes, between 1980 and 2013 (Source: *Institute for Health Metrics and Evaluation, 2015a*).



**Figure 6.** Prevalence of overweight and obesity in Mozambique, in 1980 (above) and in 2013 (below) (Source: *Institute for Health Metrics and Evaluation, 2015a*).



**Figure 7.** Prevalence of overweight and obesity in Mozambique, in 1980 (left) and in 2013 (right), by age and sex group (Source: *Institute for Health Metrics and Evaluation, 2015a*).



### 1.2.3.2. Diet-related Noncommunicable Diseases

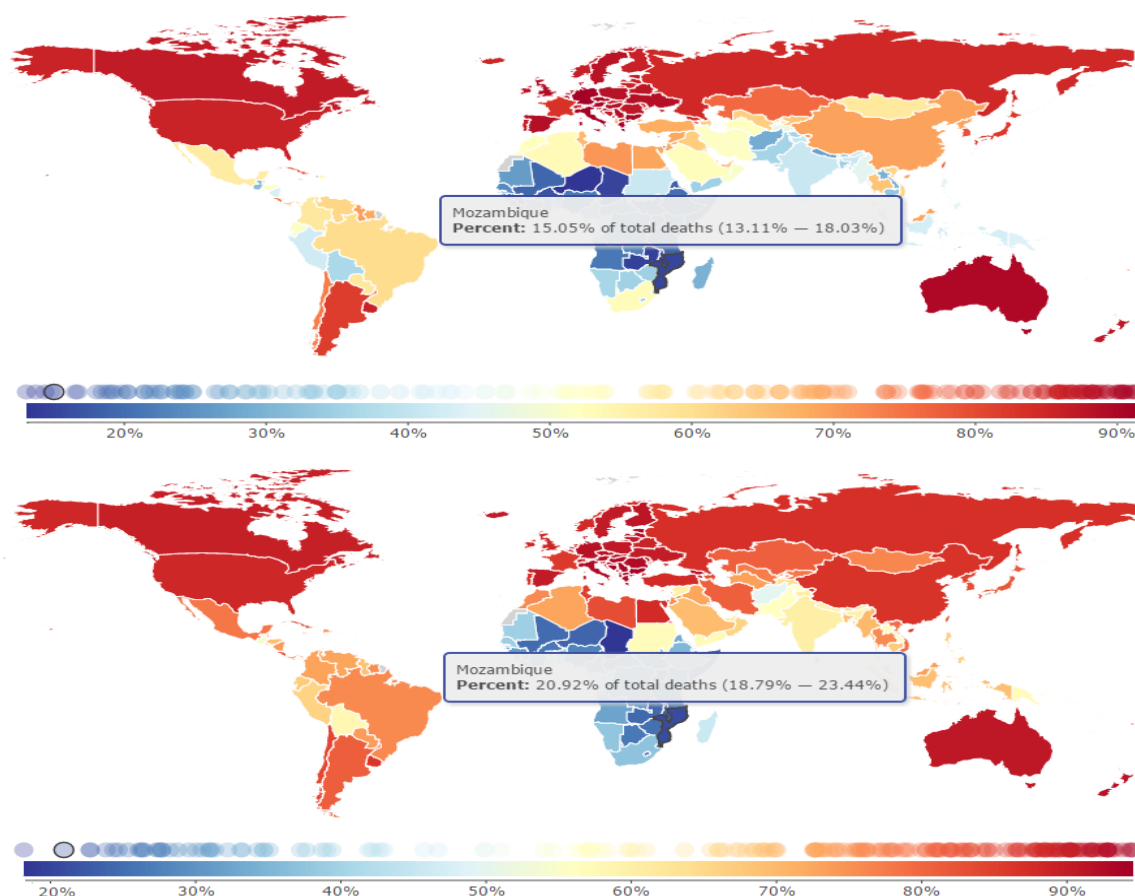
The term "non-communicable diseases" refers to a group of conditions that are not transmissible between persons. Also known as chronic diseases, they generally are characterized by long duration and slow progression, and usually require long-term treatment and health care. They may result from genetic and/or environmental causes, but the main risk factors are behavioural and modifiable, including unhealthy diets and physical inactivity, and therefore can be prevented. The four main groups of NCDs are cardiovascular diseases, cancers, respiratory diseases and diabetes, together accounting for 82% of all NCDs deaths in 2014(WHO 2015c).

We are witnessing today to a global shift towards NCDs as the number one cause of death and disability in the world(Popkin 2006, Lozano, Naghavi et al. 2012), and this is happening not only because of population growth and ageing(Lozano, Naghavi et al. 2012), but also due to lifestyle changes in a world increasingly more urbanized(Hawkes 2006, Popkin 2011). Nowadays, NCDs kill approximately 38 million people every year, around the world(WHO 2015c). Between 1990 and 2010, the number of deaths from NCDs increased 30.0% worldwide: 8 million people died from cancer in 2010, with an increase of 38% since 1990; altogether, ischaemic heart disease and stroke killed one in four people in 2010, compared with one in five in 1990; finally, the number of deaths due to diabetes doubled, reaching 1,3 million in 2010(Lozano, Naghavi et al. 2012). Furthermore, while the annual number of deaths due to infectious disease is projected to decline, the total mortality from NCDs is estimated to grow to 52 million people by 2030(WHO 2014).

Of all deaths caused by NCDs, almost three quarters (28 million) occur in low- and middle-income countries. Age-standardized NCDs death rate was highest in the lowest-income countries, exceeding 650 per 100000 in the WHO African, South-East Asia and Eastern Mediterranean Regions(WHO 2014).

Specifically in Mozambique, according to data from the IHME of the GBD, in 2013 NCDs were responsible for 20.9% of the country's adult population (older than 20 years), constituting a significant increase compared to 1990, when the adult death rate by NCDs was 15,05%(IHME 2015b) (**Figure 8**). Mortality from stroke shifted from the 12<sup>th</sup> cause of death in 1990 to the 6<sup>th</sup> position in 2010, being the most impressive NCDs repercussion change during the last decades in Mozambique(IHME 2015b). In 2005, hypertension affected nearly one third of the adult Mozambicans(Damasceno, Azevedo et al. 2009). Finally, around 20% of the Mozambican population has 3 or more risk factors for NCDs(Nnyepi, Gwisai et al. 2015), thus supporting the notion that this probably will continue to be a significant problem in the future, raising concerns about the next generations' health.

**Figure 8.** Percentage of total deaths due to non-communicable diseases in Mozambique, in 1990 (above) and in 2013 (below) (Source: Institute for Health Metrics and Evaluation, 2015b).





### 1.3. Street Food: a rising trend

The term "street food" is defined by the Food and Agriculture Organization (FAO) of the UN as "ready-to-eat foods and beverages prepared and/or sold by vendors or hawkers especially in the streets and other similar places"(FAO 2015a), being reiterated by the WHO in 1996(WHO 1996). This definition emphasises the retail location "on the street", with foods sold from pushcarts, bicycles, baskets or balance poles, or from stalls that do not have four permanent walls, distinguishing street food vendors from more formal food service operations, such as cafés, chopbars or restaurants(Fellows and Hilmi 2012).

Street-vended foods present great heterogeneity regarding their ingredients, preparation/cooking methods and degree of food processing(Fellows and Hilmi 2012). Food offer can vary greatly, comprising fresh fruits and vegetables, home-made dishes and highly industrialized snacks and beverages(Draper 1996). This variety translates into a wide range of food options, which can fit into diverse needs, lifestyles and food habits.

Street food vendors can be classified as mobile or stationary. Mobile vendors sell their products on foot, using bicycles or push carts. Stationary vendors usually sell from a stall and are strategically located, close to bus or train stations, commercial centres, schools, hospitals and residential areas, where the flow of people is expected to be higher(Fellows and Hilmi 2012).

Worldwide, it is estimated that about 2.5 billion people consume street food every day, reflecting the increasing popularity of street food that has been observed during the last decades, occurring alongside with an increasingly urbanized world(Fellows and Hilmi 2012, Gelormini, Damasceno et al. 2015). Due to time restrictions, cooking and preparation of meals at home has significantly decreased amongst urban dwellers(Winarno and Allain 1991, Popkin 1999). As such, street food provides an appealing option, as it presents accessible, convenient, inexpensive and tasteful alternatives to everyday meals(Winarno and Allain 1991, Gelormini, Damasceno et al. 2015).

Street food business has also gained socioeconomic importance, representing a substantial source of employment generation and contributing significantly to the household incomes of the vendors, particularly in the urban areas of developing countries(Winarno and Allain 1991, Fellows and Hilmi 2012). Thus, street food constitutes an undeniable trend of the 21<sup>st</sup> century, representing a socioeconomic and cultural phenomenon, that is closely related to the growing urbanization(Fellows and Hilmi 2012, Gelormini, Damasceno et al. 2015).

According to FAO, street-vended foods and beverages can provide nutritionally balanced meals outside the home with important amounts of nutrients, especially for low- and medium-income populations, provided that the consumer is well informed and able to choose the proper combination of foods(FAO 2015b). However, the nutritional value of the street-vended food products is widely variable, depending on the ingredients used (some of which are country-specific), how they are prepared and/or cooked, and also the food processing methods they suffered, if any. In addition, deeper investigation is required in order to obtain quantitative data on street food offer and consumption, as well as the contribution of street foods to the nutrient intakes of their consumers(Namugumya and Muyanja 2012, Steyn, McHiza et al. 2014).

A systematic review on street food nutritional contribution showed that street food has a significant dietary contribution to the everyday diet of many people in developing countries, frequently serving as a replacement for home meals. In this study, energy daily intake from street food ranged between 13% and 50% in adults and from 13% to 40% in children; street foods contributed significantly to the daily intake of protein, often at 50% of the RDA; also, in numerous studies reviewed it is estimated a high contribution of street foods to the total intakes of fat, *trans*-fat, salt and sugar(Steyn, McHiza et al. 2014), the last results being of some concern, taking into account the role of those nutrients in the development of obesity and other diet-related NCDs(Remig, Franklin et al. 2010, EU 2014, Gulati and Misra 2014, WHO 2015d).

Due to its informal nature, street food has been raising concerns regarding food safety, mainly because sanitary surveillance and legal control are virtually nonexistent(Ekanem 1998). Research on street food has been focusing predominantly on food safety, whereas information on availability and nutritional composition is scarce. Specifically in Mozambique, studies on street food offer and nutritional value are, to our knowledge, nonexistent.

## **2. Objectives**

### **2.1. General objective**

The general objective of this work is to contribute to an increase in the knowledge of street food, its relevance in the international literature and its characterization in Maputo, Mozambique.

### **2.2 Specific objectives**

The specific objectives of this work are:

- To assess the street food offer in Maputo;
- To evaluate the nutritional composition of the most frequent street food in Maputo;
- To classify street foods offered in Maputo, according to its processing extension;
- To collaborate in a scoping review of internationally published articles about street food, the later being the result of a partnership with a Public Health Masters student at FMUP - Faculdade de Medicina da Universidade do Porto.

### 3. Methodology

The study presented on this thesis was performed in the context of the project STOOD map, designed by a multidisciplinary team, comprising professionals of different institutions of Porto and Maputo, working in collaboration with each other. This project was developed under the auspices of the Italian Cooperation Agency of Mozambique, with the contribution of different departments and Faculties of two Universities: the Eduardo Mondlane University of Maputo, Mozambique, and the University of Porto, Portugal.

This cross-sectional study was based on a transversal evaluation of a sample of 968 street food vending sites, identified in the district of KaMpfumu, Maputo, between the months of October and November of 2014. Interviews were performed by trained researchers, using for this purpose an electronic questionnaire. Statistical analysis was performed using the software *Statistical Package for Social Sciences* (SPSS Inc., version 22.0).

All participants gave consent before responding to the questionnaire, taking into account the declaration of Helsinki of the World Medical Association. This study was approved by the National Committee for Bioethics for Health in Mozambique.

## 4. Article

This dissertation includes the following manuscript submitted to publication:

Sousa S, Gelormini M, Damasceno A, Lopes SA, Maló S, Chongole C, Muholove P, Casal S, Pinho O, Moreira P, Lunet N, Padrão P. Street food in Maputo, Mozambique: availability and nutritional value of home-cooked foods [submitted for publication].

I collaborated in the definition of objectives, data collection, analysis, interpretation and discussion of the results. I was also the responsible for the redaction of the first draft and I actively participated elaboration of the final version of this article.

## Article

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Sousa S, Gelormini M, Damasceno A, Lopes SA, Maló S, Chongole C, Muholove P, Casal S, Pinho O, Moreira P, Lunet N, Padrão P. Street food in Maputo, Mozambique: availability and nutritional value of home-cooked foods.

**Street food in Maputo, Mozambique: availability and nutritional value of home-cooked foods**

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34 **Running title:** Street food in Maputo, Mozambique

35

36 **Keywords:** street food, nutritional composition, ready-to-eat-food, Mozambique, Africa



## 37    **Abstract**

38    Street food (SF) represents a cultural, social and economic phenomenon, closely related to  
 39    urbanization. This study aimed to characterize the SF offer in Maputo, Mozambique and the  
 40    nutritional composition of the home-cooked foods. Streets in the surroundings (500-meter buffer) of  
 41    randomly selected public transport stops were canvassed to identify all SF vending sites in the area.  
 42    Information regarding food products offer was gathered through interview and observation in each  
 43    identified vending site. Food samples were collected for laboratorial nutritional analysis. A total of  
 44    968 SF vending sites were identified in the district of KaMpfumu, corresponding to a density of  
 45    118.5 vending sites/km<sup>2</sup>; 77.4% of which were stationary (density: 91.7 vending sites/km<sup>2</sup>) and  
 46    22.6% were mobile (density: 26.8 vending sites/km<sup>2</sup>). Fruit, beverages and food other than fruit  
 47    were available in 24.5%, 32.5%, and 73.9% of the vending sites, respectively. A high variability in  
 48    the nutritional composition of foods was observed, reflecting very diverse food types. Fried cakes  
 49    were the most energy-dense (430kcal/100g) and the richest in fats (21.0g/100g) and carbohydrates  
 50    (53.4g/100g) whereas the richest sources of protein were the stewed meat/fish dishes (range: 10.7-  
 51    11.6g/100g). Fried cakes showed the lowest sodium and potassium content (90mg/100g and  
 52    81mg/100g, respectively) whereas hamburgers exhibited the highest content of those micronutrients  
 53    (455 mg/100g and 183 mg/100g, respectively). SF offer in Maputo was abundant and scattered  
 54    throughout the urban district. Our findings reinforce the need for health policies targeted to SF  
 55    improvement, especially concerning the promotion of nutritional dense foods, and with reduced  
 56    added salt.

## 57 Introduction

58 The Food and Agriculture Organization of the United Nations defined in 1989 the term  
 59 "street food" as "ready-to-eat foods and beverages prepared and/or sold by vendors and handlers  
 60 especially in streets and other similar public places, for immediate consumption or consumption at a  
 61 later stage without further processing or preparation"<sup>(1)</sup>, being reiterated by the World Health  
 62 Organization in 1996<sup>(2)</sup>. Currently, an estimated 2.5 billion people around the world eat SF every  
 63 day<sup>(3)</sup>, representing a cultural, social and economic phenomenon, which is closely related to  
 64 urbanization.

65 Urbanization is one of the world's greatest trends of the 21<sup>st</sup> century, not only limited to the  
 66 most developed regions. In fact, according to data from the United Nations, all regions are expected  
 67 to continue urbanizing over the future decades, but Africa and Asia are currently the continents  
 68 where this process is faster, together concentrating nearly 90% of the projected world's urban  
 69 population growth between 2014 and 2050. Mozambique is no exception; in Maputo, the capital of  
 70 Mozambique, the number of inhabitants living in urban agglomerations grew from 92.000 in 1950  
 71 to 1.187.000 in 2015, and is expected to reach 1.893.000 by 2030<sup>(4)</sup>.

72 Among urban societies, time dedicated to cooking at home has been declining drastically<sup>(5;</sup>  
 73 <sup>6)</sup>, and SF constitutes a cheap and easily accessible option, becoming an increasingly popular food  
 74 source<sup>(6; 7)</sup>. Urbanization frequently involves westernization of food habits, in a process that  
 75 includes a number of dietary changes: on one hand, the consumption of non-processed or minimally  
 76 processed foods, nutritionally more dense (e.g. fruit, vegetables, legumes and whole grains) usually  
 77 declines; on the other hand, the intake of highly-processed foods, much more likely to be energy  
 78 dense, rich in fat (specially saturated and *trans* fat), refined carbohydrates, sugars and salt, tends to  
 79 increase<sup>(8; 9; 10)</sup>.

80 The first study following the World Health Organization (WHO) Stepwise Approach to  
 81 Chronic Disease Risk Factor Surveillance (STEPS) conducted in Mozambique showed very low

82 fruit and vegetables intake compliance<sup>(11)</sup>. In addition, a survey of a convenience sample of the  
83 adult general population from Maputo showed a frequent use of ultra-processed food products, such  
84 as sugar sweetened beverages and chicken powdered stocks<sup>(12)</sup>.  
85 Nevertheless, there is limited research on the dietary habits of Mozambicans and information on the  
86 availability and nutritional composition of SF, is non-existent. The present study aims to  
87 characterize the SF offer in Maputo, Mozambique, and nutritional composition of home-cooked  
88 foods.

## 89 **Experimental Methods**

90 We conducted a cross-sectional study to assess a sample of SF vending sites in Maputo,  
91 Mozambique, as described in a previously published protocol<sup>(13)</sup>.

### 93 **1) Eligibility criteria for selection of Street Food Vending Sites**

94 For the purpose of this work, SF vending sites were defined as a business establishments  
95 selling ready-to-eat food or beverages from any venue in the streets, including carts, trucks, stands,  
96 and a variety of improvised informal setups (e.g. shopping carts, trunks of cars, sides of vans,  
97 buckets, coolers, etc.), as well as “in-transit” SF vending sites.

98 The exclusion criteria were as follows: (1) food establishments within four permanent walls;  
99 (2) permanent storefront business; (3) street vending sites selling exclusively non-food products or  
100 raw foods not ready-to-eat; (4) street vending sites operating in closed public spaces (markets) or  
101 organized entities (farmers markets, food fairs); and (5) food stalls and carts that are part of  
102 permanent stores or licensed establishments.

103

### 104 **2) Sampling Procedure**

105 The administrative repartition of Maputo comprises seven municipal districts. This study  
106 was limited to the district of KaMpfumu, which is the most urbanized<sup>(14)</sup>, and also considered to  
107 represent the area with the highest concentration of SF vending sites.

108 Within the KaMpfumu district, we identified a total of 134 public transport stops. Among  
109 them, 20 stops were randomly selected. To identify the study area, we considered a 500 meters  
110 buffer around each selected stop, excluding those portions that fall outside the administrative  
111 borders of the municipal district and eliminated overlapping areas.

112 For this sampling procedure, we used the public transport stops distribution of the  
113 Government of Mozambique<sup>(15)</sup> and other maps produced by the Maputo Municipal Council  
114 (Conselho Municipal Cidade de Maputo)<sup>(14)</sup>.

### 115    **3) Data Collection**

116            Field researchers operated in pairs, walking through each publicly accessible street in the  
 117    selected area and approaching every identified SF vending site, according to the abovementioned  
 118    criteria. The interviews were carried out daily, during working days, from 9:00 am to 4:00 pm.  
 119    Training of the interviewers, as well as standardized procedures for data collection were  
 120    implemented, in order to minimize the proportion of missing data and increase data quality.

121            In addition to assessing some business characteristics (mobility and type of vending site),  
 122    researchers gathered information regarding the food being sold, namely type of food products  
 123    available and size of portions. SF vendors were asked if they agree to collaborate in the data  
 124    collection and to participate in the interview. The questionnaire was carried out in the case of a  
 125    positive response.

126            Socio-demographic data of the vendors were collected. SF vending sites were characterized  
 127    according to the type of physical setup (e.g. stand, stall, coleman, etc.) and its mobility (mobile or  
 128    permanent). The food products sold were identified and classified into three groups: fruit, beverages  
 129    and food other than fruit. Ready-to-eat food products which fell into the category of food other than  
 130    fruit were classified as homemade or industrial. Homemade food was also grouped in “cooked”,  
 131    “prepared but non-cooked” and “non-cooked and non-prepared”. Beverages were grouped  
 132    according to similarities of composition into the following groups: soft drinks, water, fruit juices,  
 133    milk, yogurt, alcoholic beverages, energetic drinks, *maheu* (homemade fermented beverage made  
 134    with water, corn flour and sugar), and other beverages (e.g. tea, tea with milk).

135            To prevent vendors from being interviewed twice, the questionnaire started with a control  
 136    question asking if the vendor has already been interviewed. Furthermore, at the end of each  
 137    interview, each vendor was provided with a sticker with the logo of the research project, in order to  
 138    signal to other interviewers that this vendor has already participated in the study.

139            When the vendor did not agree to participate in the study, or in any circumstance that made  
 140    impossible the interview, some data was gathered through observation of the vending site.

#### 141 **4) Nutritional Composition Assessment**

142 Samples of the most common home-made foods were collected for bromatological  
 143 analysis in a specialized laboratory. The 29 most available foods comprised 14 main dishes, three  
 144 fried snacks, two hamburgers, eight sandwiches and two fried cakes. It was also taken into account  
 145 the diversity and variability of home-cooked foods amongst street vending sites. A sample of each  
 146 dish, corresponding to one portion, was bought whenever possible from different vending sites  
 147 randomly selected and properly stored at freezing temperature until bromatological analysis was  
 148 conducted.

149 Before analysis, samples were defrosted and total weight was compared to detect moisture  
 150 losses during storage and shipping. The following analyses were conducted, at least in duplicate: (1)  
 151 moisture analysis by oven drying at 103°C until constant weight<sup>(16)</sup>; (2) total fat and protein content  
 152 determination by the Soxhlet and Kjeldahl procedures, respectively, and total carbohydrates plus  
 153 fibre estimation by difference<sup>(16)</sup>; (3) fatty acids analysis using gas chromatography for the fatty  
 154 acid ethyl esters, according to a validated method<sup>(17)</sup>; (4) total sodium and potassium analysis by  
 155 flame photometry<sup>(18)</sup>. Results were expressed per 100g of fresh mass.

156

#### 157 **5) Ethical considerations**

158 No data referring to human subjects or any personally identifiable information were  
 159 collected, since the target of this study was not the vendors, but the food and vending site. As such,  
 160 informed consent was considered as unnecessary.

161 The protocol was approved by the National Committee for Bioethics for Health in  
 162 Mozambique (Comité Nacional de Bioética para a Saúde, Ref. 223/CNBS/14).

## 163 Results

164 A total of 968 SF vending sites were identified, 810 (83.7%) of them were assessed and in  
 165 158 (16.3%) the vendors were not available/willing to participate. Nevertheless, in those  
 166 circumstances some data were collected by observation, namely regarding the type of the vending  
 167 site and the food products sold (fruit, beverages and food other than fruit).

168 The description of the physical setups of the vending sites is presented in **Table 1**; the stand  
 169 was the setup in nearly half the vending sites (45.8%). The mapping of stationary (n=749, 77.4%)  
 170 and mobile (n=219, 22.6%) vending sites is depicted in **Figure 1**; both types were observed in the  
 171 different neighbourhoods of the area evaluated, corresponding to a density of approximately 118.5  
 172 vending sites/km<sup>2</sup>. Stationary vending sites corresponded to a density of 91.7 vending sites/km<sup>2</sup>  
 173 whereas mobile vending sites corresponded to a density of 26.8 vending sites/km<sup>2</sup>.

174 The female to male ratio of street food vendors was 0.95 but there was a predominance of  
 175 male vendors in mobile vending sites (83.3% vs. 16.7%, p<0.001), whereas in stationary vending  
 176 sites most vendors were female (58.6% vs. 41.4%, p<0.001).

177 Information regarding the food products available is shown in **Table 2**. Overall, foods other  
 178 than fruit were the most frequently available, followed by beverages and fruit (73.9%, 32.5%, and  
 179 24.5% of the vending sites, respectively). However in mobile vending sites fruit was more  
 180 frequently available than beverages, which were very uncommon. Vending sites selling exclusively  
 181 industrial food prevailed (51.9%), followed by those vending exclusively home-made food (28.5%).  
 182 However, mobile vending sites sold more frequently food exclusively homemade (65.8% vs.  
 183 19.4%, p<0.001). Regarding homemade food, cooked meals, compared to prepared but non-cooked  
 184 food and to non-cooked and non-prepared food, prevailed in both types of vending sites (88.5%,  
 185 21.6%, and 11.5%, respectively). Regarding beverages, soft drinks, followed by water were the  
 186 most frequently available (92.6% and 63.9%, respectively).

187 **Table 3** shows the results of the bromatological analysis of the food samples collected. A  
 188 high variability in the chemical composition of the different foods analysed was observed, reflecting

189 very diverse types of food from stewed meat or dishes to fried snacks and cakes. The mean energy  
 190 value per serving was highest for peanut based curry dishes followed by hamburgers (852 kcal and  
 191 620 kcal, respectively). However, fried cakes were the most energy-dense of all the analyzed foods  
 192 (430kcal/100g), followed by fried snacks (359kcal/100g); both groups of foods were also the richest  
 193 in total fat (21.0g/100g and 24.3g/100g, respectively), saturated, mono- and polyunsaturated, n-6, n-  
 194 3 and *trans* fatty acids. Fried cakes were also the foods containing the highest amount of  
 195 carbohydrates (53.4g/100g), followed by sandwiches (39.0g/100g). The richest sources of protein  
 196 were the stewed meat and fish dishes (11.3g/100g and 11.6g/100g, respectively). Fried cakes  
 197 showed the lowest sodium and potassium content (90mg/100g and 81mg/100g, respectively)  
 198 whereas hamburgers exhibited the highest content of those micronutrients (455 mg/100g and 183  
 199 mg/100g, respectively). Sodium/potassium ratio ranged from 1.11 in fried cakes to 7.03 in stewed  
 200 liver dishes.



## 201 Discussion

202

203 This research presents relevant original data on offer, energy content, and nutritional  
 204 composition of the ready-to-eat food products available in SF vending sites in Maputo,  
 205 Mozambique. There was a high availability of SF in Maputo, which is demonstrated by the  
 206 existence of several hundreds of SF vending sites in the most urbanized district of Maputo city, and  
 207 a wide variety of food products.

208 It was interesting to find a coexistence of highly processed industrialized food products with  
 209 natural foods and homemade dishes. This constitutes a strong reflection of the nutrition transition  
 210 phenomenon that Mozambique is currently undergoing. According to the nutrition transition model  
 211 proposed by Popkin<sup>(19)</sup>, which comprises five stages (*Collecting food*; *Famine*; *Receding famine*;  
 212 *Degenerative disease*; and *Behavioral change*), Mozambique, at least the urban centres, is believed  
 213 to be quickly moving from stage 3 (*Receding famine*) to stage 4 (*Degenerative disease*)<sup>(8)</sup>. Stage 3 is  
 214 characterized by a decrease in the consumption of starchy staples and an increase in sources of  
 215 animal protein, fruit and vegetables, along with an increase in urbanization, income and life  
 216 expectancy; whereas stage 4 is characterized by a raise of processed food rich in sugar and fat,  
 217 along with the evolution of food-transforming technologies. Our findings on SF offer in Maputo  
 218 corroborate with the suggested position of Mozambique regarding the nutrition transition model.

219 Regarding homemade food, there was a predominance of homemade cooked food in both  
 220 mobile and stationary SF vending sites. However, through *in loco* observation and photographic  
 221 records analysis, it was possible to observe that processed ingredients, mainly chicken powdered  
 222 stocks (e.g. *Knorr*<sup>®</sup>, *Benny*<sup>®</sup>), were massively used in most culinary preparations, not only being  
 223 frequently added during cooking, but also to food already prepared which is in accordance with the  
 224 observations of a previous study on food consumption in Maputo<sup>(12)</sup>. Since chicken powdered  
 225 stocks have very high sodium contents, the assessment of their use is of great importance.

226 Almost all the samples evaluated by bromatological analysis showed high amounts of  
 227 sodium. The upper limit of the 2000 mg recommended by the WHO <sup>(20)</sup> may be easily exceeded by  
 228 consuming any SF option analyzed. For instance, one hamburger or one portion of a stewed meat  
 229 dish may contribute with more than half of the WHO upper limit. More importantly, high  
 230 sodium/potassium ratio were observed in virtually all preparations. The WHO guidelines for  
 231 sodium and potassium intake recommend that the ratio of sodium to potassium daily ingested would  
 232 be approximately one to one<sup>(20; 21)</sup>, a value that is far exceeded in our samples. Considering the  
 233 extensively documented hazards to health associated with the excessive consumption of sodium <sup>(22)</sup>,  
 234 there is room to decrease the addition of salt in home-made food preparations and to promote the  
 235 consumption of potassium-rich foods such as fruit and vegetables.

236 The most frequently available foods other than fruit fall within the category of industrial.  
 237 Studies using food classification based on processing extent showed that the high availability and  
 238 consumption of industrialized foods is linked to a lower quality of the diet (with higher energy  
 239 density, more added sugar, saturated fat and sodium; and with less fibre), which impacts on human  
 240 health, by increasing the prevalence of obesity and chronic non-communicable diseases<sup>(23; 24)</sup>.  
 241 Consumption of industrialized foods was also associated to higher body mass index, as well as  
 242 increased likelihood of being overweight or obese, both in adolescents and adults<sup>(25)</sup>.

243 Data from bromatological analysis showed a high variability in energy content and  
 244 macronutrient values of the food products available. This can be explained by the observed  
 245 heterogeneity of street vended foods, which include products with different type and number of  
 246 ingredients, complexity and degree of processing<sup>(26)</sup>. The nutritional composition of the food  
 247 products analyzed showed on average a predominance of carbohydrates and fats compared to  
 248 proteins, which is in line with other studies. A systematic review on nutritional contribution of SF  
 249 in developing countries<sup>(27)</sup> in which Mozambique was included reported a high contribution of SF  
 250 to daily intakes of fat, *trans* fat and sugar, which is of great concern due to the role of those  
 251 nutrients in the development of obesity and chronic non-communicable diseases<sup>(28; 29; 30; 31)</sup>.

252 The focus of this work was to contribute to a better understanding of nutrition transition in  
 253 Mozambique and its epidemiologic implications, analysing the foods and the key nutrients for diet-  
 254 related NCDs, so data on micronutrient composition other than sodium and potassium was not  
 255 collected. The assessment of sodium and potassium, as well as its ratio, represents a novel approach  
 256 especially in regard to SF characterization.

257 It is important to point out that the carbohydrates content obtained from bromatological  
 258 analysis refers, in reality, to carbohydrates plus fibre. This might have implications on the energy  
 259 contents, whose values were probably slightly overestimated. However, since the dishes identified  
 260 have no considerable amounts of vegetables, whole grains or other high-fibre foods, the error on the  
 261 energy values is expected to be low. Another limitation of the present research was the inability to  
 262 discriminate sugars within carbohydrates. Nonetheless, this study reported on the availability of  
 263 high sugary foods in the SF vending sites of Maputo, such as soft drinks, confectionary, cookies,  
 264 cakes, and popcorn, which allows us to have a broad picture on the overall potential consumption of  
 265 sugary foods.

266 Taking together, the evidences collected suggest that a shift towards a more westernized  
 267 lifestyle is occurring at least in urban areas of Mozambique<sup>(12)</sup>, supporting the concept that  
 268 Mozambique is currently undergoing the nutrition transition. An upward trend of non-  
 269 communicable diseases (NCDs), formerly regarded as exclusive to the developed world, such as  
 270 cardiovascular diseases, cancer, and diabetes, a phenomenon widely known as epidemiologic  
 271 transition, follows lifestyle changes<sup>(8)</sup>. In Mozambique, in 2013 NCDs were already responsible for  
 272 20.9% of the mortality of the adult population, reflecting a significant increase compared to 15.1%  
 273 in 1980. Therefore, it is essential to monitor lifestyle risk factors for NCDs, namely food  
 274 consumption, over time to identify changes that allow for the development of policies and strategies  
 275 to prevent diet-related chronic diseases.

276 In conclusion, SF offer in Maputo is abundant and fully distributed throughout the urban  
 277 district. Carbohydrates were the major contributors to total energy content of the SF available,

278 followed by fat, whereas proteins showed a lower energy contribution to the food products  
 279 available. To our knowledge this research provides the first characterization of the SF offer in  
 280 Mozambique. It is also the first study with original data on nutritional composition of the street  
 281 vended food products in that country. Since SF presents a significant dietary contribution to the  
 282 everyday diet of many people, frequently serving as a replacement for home meals<sup>(27)</sup>, our findings  
 283 reinforce the need for health policies targeted to the improvement of the food products sold on the  
 284 street, in order to curb the upward trend of diet-related NCDs that is arising in this country.

285

286

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291

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**Table 1 – Physical setups of the street food vending sites in Maputo, Mozambique (N=968).**

	n* (%)
Stand	443 (45.8)
Bowl or tray	145 (15.0)
Plastic/cardboard box	109 (11.3)
Stall	88 (9.1)
Coleman	85 (8.8)
Pushcart	58 (6.0)
Trunk	31 (3.2)
Bucket	20 (2.1)
Bag/plastic on the floor	17 (1.8)
Truck	11 (1.1)
Cardboard on the floor	8 (0.8)
Tables and chairs	4 (0.4)
Others	20 (2.1)

\*The sum of the values is higher than the total number of vending sites (N=968) because each vending site could have more than one physical setup.

**Table 2 - Ready-to-eat food products available in street food vending sites, in Maputo, Mozambique (N=968).**

	Street food vending sites			p
	Total n (%)	Mobile n (%)	Stationary n (%)	
<b>Food other than fruit*</b>	<b>715 (73.9)</b>	<b>138 (63.0)</b>	<b>577 (77.0)</b>	<b>&lt;0.001†</b>
Homemade	170 (28.5)	77 (65.8)	93 (19.4)	
Industrial	310 (51.9)	22 (18.8)	288 (60.0)	<b>&lt;0.001‡</b>
Homemade and industrial	117 (19.6)	18 (15.4)	99 (20.6)	
<b>Cooking/preparation of homemade food§</b>				
Homemade cooked (e.g. curry dishes)	254 (88.5)	85 (89.5)	169 (88.0)	0.717
Homemade prepared but non-cooked (e.g. salad)	62 (21.6)	11 (11.6)	51 (26.6)	0.004†
Homemade non-cooked and non-prepared (e.g. nuts)	33 (11.5)	8 (8.4)	25 (13.0)	0.250
<b>Beverages*</b>	<b>315 (32.5)</b>	<b>3 (1.4)</b>	<b>312 (41.7)</b>	<b>&lt;0.001†</b>
<b>Soft drinks</b>	<b>249 (92.6)</b>	<b>1 (33.3)</b>	<b>248 (93.2)</b>	<b>0.015†</b>
Regular	238 (95.6)	1 (100.0)	237 (95.6)	
Regular and light	11 (4.4)	0 (0.0)	11 (4.4)	1.000
<b>Water</b>	<b>172 (63.9)</b>	<b>1 (33.3)</b>	<b>171 (64.3)</b>	<b>0.296</b>
Bottled	164 (95.3)	0 (0.0)	164 (95.9)	
Other (e.g. tap, bore water)	4 (2.3)	1 (100.0)	3 (1.8)	<b>&lt;0.001‡</b>
Bottled and other	4 (2.3)	0 (0.0)	4 (2.3)	
<b>Fruit juices</b>	<b>56 (20.8)</b>	<b>1 (33.3)</b>	<b>55 (20.7)</b>	<b>0.505</b>
Natural	0 (0.0)	0 (0.0)	0 (0.0)	
Industrial	56 (100.0)	1 (100.0)	55 (100.0)	1.000
<b>Milk§</b>	<b>13 (4.8)</b>	<b>0 (0.0)</b>	<b>13 (4.9)</b>	<b>1.000</b>
Fresh milk	13 (100.0)	-	13 (100.0)	-
Powdered milk	1 (7.7)	-	1 (7.7)	-
Condensed milk	4 (30.8)	-	4 (30.8)	-
<b>Yogurt</b>	<b>21 (7.8)</b>	<b>1 (33.3)</b>	<b>20 (7.5)</b>	<b>0.217</b>
<b>Alcoholic beverages§</b>	<b>31 (11.5)</b>	<b>0 (0.0)</b>	<b>31 (11.7)</b>	<b>1.000</b>
Beer	27 (87.1)	-	27 (87.1)	-
Whisky	14 (45.2)	-	14 (45.2)	-
Wine	11 (35.5)	-	11 (35.5)	-
Porto wine	1 (3.2)	-	1 (3.2)	-
Gin	3 (9.7)	-	2 (6.5)	-
<b>Energetic drinks</b>	<b>16 (5.9)</b>	<b>0 (0.0)</b>	<b>16 (6.0)</b>	<b>1.000</b>
Regular	14 (87.5)	-	14 (87.5)	-
Regular and light	2 (12.5)	-	2 (12.5)	-
<b>Maheu  </b>	<b>6 (2.2)</b>	<b>0 (0.0)</b>	<b>6 (2.3)</b>	<b>1.000</b>
<b>Other beverages: tea, tea with milk, etc.</b>	<b>16 (5.9)</b>	<b>0 (0.0)</b>	<b>16 (6.0)</b>	<b>1.000</b>
<b>Fruit*</b>	<b>237 (24.5)</b>	<b>82 (37.4)</b>	<b>155 (20.7)</b>	<b>&lt;0.001†</b>

\*For the main categories "Food other than fruit", "Beverages" and "Fruit" we have information on all vending sites. For specific sub-categories within those groups, we have information on the vending sites whose vendors were available for interview; †Statistically significant differences according to Fisher's exact test, for a confidence level of 95% (p-value<0.05); ‡Statistically significant differences according to Pearson's Chi-square test, for a confidence level of 95% (p-value<0.05); §The sum of the values for this variable is higher than the total number of vending sites (N=968) due to multiple choice answers; ||Homemade fermented beverage made with water, corn flour and sugar.

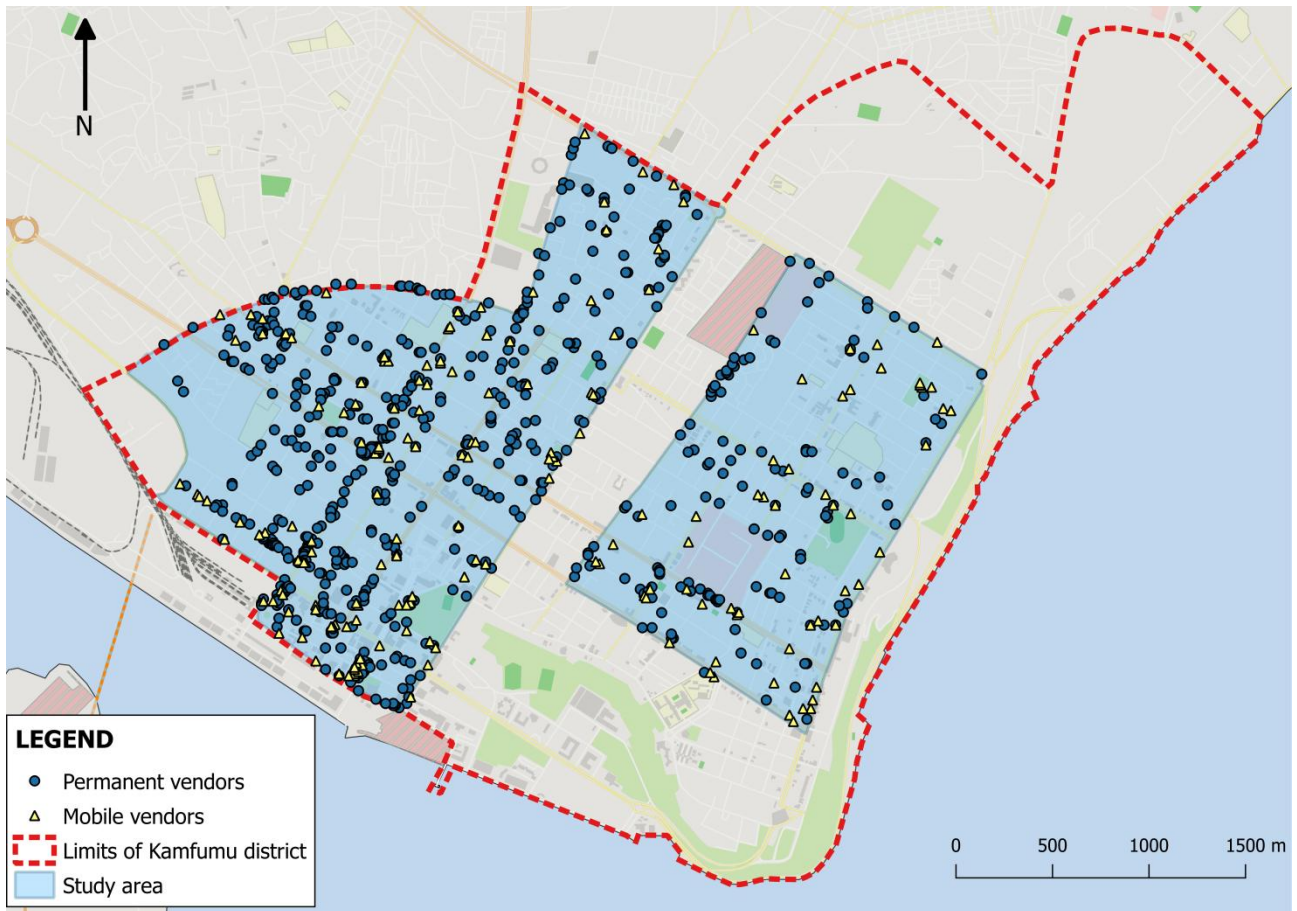


381 **Table 3 - Averages of nutritional composition of the home-cooked street food samples evaluated by bromatological analysis.**  
382

		Energy and macronutrients (g/100g)											Micronutrients (mg/100g)				
		mean (standard deviation)											mean (standard deviation)				
	N	kcal/serving mean (S.D.)	kcal/100g mean (S.D.)	Water	Protein	CHO	Total fat	SFAs	MUFAs	PUFAs	n-6	n-3	TFAs	n	Na	K	Na/K ratio
Peanuts-based dishes*	8	852 (186.2)	142 (22.6)	69.8 (4.2)	8.3 (3.2)	15.4 (6.3)	5.3 (2.4)	1.85 (0.62)	1.82 (0.94)	1.55 (0.96)	1.42 (0.86)	0.11 (0.12)	0.01 (0.02)	7	258 (85.8)	116 (37.7)	2.28 (0.63)
Stewed meat dishes†	32	466 (178.8)	152 (31.7)	67.0 (3.6)	11.3 (3.8)	14.2 (4.0)	5.8 (2.8)	1.93 (1.14)	2.17 (1.28)	1.68 (0.79)	1.51 (0.71)	0.14 (0.09)	0.04 (0.03)	31	354 (106.2)	155 (75.4)	3.24 (4.08)
Stewed fish dishes	4	558 (90.9)	141 (23.0)	68.1 (4.0)	11.6 (4.0)	14.1 (2.1)	4.3 (1.8)	1.39 (0.80)	1.46 (0.72)	1.34 (0.92)	1.17 (0.87)	0.06 (0.09)	0.02 (0.01)	3	453 (149.2)	173 (103.4)	3.39 (1.93)
Stewed liver dishes	4	372 (23.2)	171 (10.7)	63.2 (1.4)	10.7 (0.9)	18.5 (2.0)	6.1 (1.2)	2.11 (0.28)	1.81 (0.17)	2.03 (1.33)	1.83 (1.20)	0.16 (0.13)	0.04 (0.01)	4	326 (84.4)	181 (136.9)	7.03 (10.73)
Fried snacks‡	13	208 (51.4)	359 (88.4)	38.8 (10.5)	8.3 (0.9)	26.6 (5.6)	24.3 (9.9)	6.76 (4.63)	8.44 (4.02)	9.04 (5.33)	8.37 (5.05)	0.47 (0.50)	0.20 (0.12)	3	406 (85.8)	116 (65.9)	4.66 (3.16)
Hamburgers§	4	620 (36.8)	257 (15.3)	42.9 (3.1)	10.3 (0.7)	26.7 (4.0)	12.1 (1.7)	4.36 (1.39)	4.55 (0.86)	2.87 (0.45)	2.73 (0.45)	0.08 (0.03)	0.07 (0.01)	2	455 (7.1)	183 (31.8)	2.52 (0.40)
Sandwiches	12	442 (44.0)	268 (26.7)	41.1 (5.8)	10.0 (1.0)	39.0 (8.0)	8.0 (4.0)	2.84 (1.67)	3.02 (1.73)	2.02 (1.33)	1.90 (1.24)	0.10 (0.09)	0.03 (0.02)	6	452 (115.6)	159 (40.6)	3.10 (1.49)
Fried cakes¶	3	131 (18.8)	430 (61.8)	17.9 (4.9)	6.9 (0.3)	53.4 (6.6)	21.0 (9.3)	7.07 (2.81)	6.84 (2.90)	6.86 (7.29)	6.19 (6.52)	0.50 (0.71)	0.16 (0.11)	1	90	81	1.11

383 SF, street-food. CHO, carbohydrates. SFAs, saturated fatty-acids. MUFAs, monounsaturated fatty-acids. PUFAs, polyunsaturated fatty-acids. TFAs, trans fatty acids. Na, sodium. K,  
384 potassium. \*Includes peanut curry with and without chicken, and *matapa* (main dish made with peanuts, coconut and cassava leaves); †Includes stewed chicken, turkey, beef, pork and goat;  
385 ‡Includes samosas, rissoles and *badjias* (fried dumplings made with beans, onion and garlic); §Includes hamburgers with eggs and/or cheese; ||The sandwiches have different combinations of  
386 ingredients in their compositions (e.g. eggs, cheese, polony); ¶Includes *gulabos* (traditional fried cake made with wheat flour, eggs, margarine, sugar and coconut) and other fried cakes.

387 **Figure 1. Geographical distribution of street food vending sites in Maputo, Mozambique,**  
 388 **including mobile (yellow triangles, n=214) and stationary (blue circles, n=717) vending sites.**



389  
 390 The total number of vending sites marked in this figure (n=931) is slightly lower than the total number of the vending  
 391 sites identified (N=968), because it was not possible to collect geographical localization of 37 vending sites.

## 5. Preliminary results of an essay of application of the processing degree methodology to street food in Maputo

It is currently recognized the importance of taking into account food processing when studying the links between food and health (Fardet, Rock et al. 2015). As such, we used a recently developed and internationally recommended methodology for food classification based on processing extension (Fardet, Rock et al. 2015, Monteiro, Cannon et al. 2016)

Using the NOVA food classification proposed by Monteiro et al., foods and beverages available in the street food vending sites identified in the presented article were classified according to their processing extent into 4 groups: (1) *In natura* or minimally processed foods (including culinary preparations using them as base), (2) processed culinary ingredients, (3) processed foods; and (4) ultra-processed foods. *In natura* foods are defined as edible parts of plants (e.g. fruits, seeds, roots) or animals (e.g. muscle, viscera, eggs), as well as mushrooms, algae and water. Minimally processed foods are *in natura* foods which are submitted to a mild processing that does not involve addition of substances like salt, sugar, fats or oils (e.g. drying, milling, refrigeration, freezing, cooking, packaging). Processed culinary ingredients are substances extracted directly from *in natura* foods, and consumed as culinary preparation ingredients (e.g. sugar, salt, butter, honey). Processed foods are defined as food products resulting from the addition of salt, sugar, oil or other processed culinary ingredients to *in natura* or minimally processed foods, using some preservation and cooking methods (e.g. bread, canned fish, cheese). Ultra-processed foods are industrial formulations, usually with 5 or more ingredients, including additives (e.g. dyes, artificial sweeteners, flavours, emulsifiers) and involving a number of processing methods with no domestic equivalent (Monteiro, Cannon et al. 2016). Within each of the four categories presented, further grouping was made according to similarities of composition.

Energy and macronutrient contents of all street foods were estimated. For home-made ready-to-eat foods and beverages, standardized recipes were used as a reference. Recipes' simulation was performed by two Mozambican nutritionists, as all the ingredients used were measured and recorded. The ingredients used for each culinary preparation were estimated according to results from a study which involved food intake evaluation of a convenience sample in Maputo, also providing specific information regarding the Mozambican context (Silva, Santos et al. 2013). Serving sizes usually consumed were estimated through analysis of the photographs taken on site. Food Processor was used to convert food ingredients into nutrients. For industrial food products, nutritional composition

was estimated using Mozambican food labels whenever possible. If those were not available, Portuguese food labels were used in alternative, considering products as similar as possible as those sold in Mozambique. In the case of *in natura* food products (e.g. fruits, nuts, cassava), nutritional composition was determined using the Mozambican food composition table(DNS 1991) and for the foods that were inexistent the nutritional information was gathered from the Brazilian(NEPA 2011) and the South African(SAFOODS 2015) food composition tables.

Preliminary results of this essay are presented in **Table 2**. Those results will be further published in another study, whose main objective will be to characterize street food offer in Maputo, Mozambique, with specific focus on its processing extension and nutritional composition.

Energy content per 100g of ultra-processed foods was significantly higher than *in natura* or minimally processed foods, which was expected. However, this difference was not observed when comparing energy content per serving, which can be explained by the weight variations of what is sold as a portion. In addition, beverages such as soft drinks and alcoholic drinks are included in the ultra-processed foods group, which dilutes the energetic value per serving within the whole group. Also, beverages and solid foods do not act as interchangeable items since they are usually consumed together and for that reason their nutritional content should not be compared. Most of the food products that are included in the group of *in natura* or minimally processed foods are main courses, which contribute to explain the larger portions. On the contrary, ultra-processed foods tend to be packaged in individual portions, usually smaller. Nevertheless, when comparing fast-food dishes that are usually consumed as main courses, the energetic content per portion was higher than the majority of the home-made dishes.

Regarding macronutrients, the ultra-processed foods group presented a predominance of carbohydrates and lipids, whereas proteins presented a minor contribution to total energy content. On the other hand, the percentage contribution to total energy of proteins was high in homemade dishes, especially those based on meats, poultry, fish/seafood and eggs, as well as some processed foods such as canned fish, processed meats and cheese.

**Table 2** - Degree of processing, energy value and nutritional composition of the ready-to-eat food products available in mobile and stationary street food vending sites, in Maputo, Mozambique (N=810, available for interview).

	N*	SF vending sites (N=810) n (%)	Serving size (g <sup>†</sup> ) mean (S.D.)§	Energy		Contribution to total energy (%)		
				kcal/serving‡ mean (S.D.)§	kcal/100g‡ mean (S.D.)§	Carbohydrates mean (S.D.)§	Protein mean (S.D.)§	Fats mean (S.D.)§
<b><i>In natura</i> or minimally processed foods (including culinary preparations using them as base)  </b>	<b>73</b>	<b>571 (70.5)</b>	<b>212 (154.4)</b>	<b>286 (267.4)</b>	<b>161 (136.0)</b>	<b>50.4 (38.6)</b>	<b>14.3 (12.6)</b>	<b>36.0 (29.2)</b>
Rice	1	47 (8.2)	141	476	338	74.2	5.7	18.3
Corn¶	4	52 (9.1)	248 (213.6)	243 (115.3)	176 (187.9)	79.0 (10.9)	7.5 (4.4)	12.1 (13.1)
Wheat**	5	75 (13.1)	108 (102.8)	251 (164.0)	319 (114.7)	51.3 (14.2)	8.1 (2.9)	38.9 (17.3)
Beef††	2	46 (8.0)	220 (72.4)	394 (74.3)	184 (26.7)	5.7 (2.2)	27.1 (3.2)	66.8 (0.7)
Pork††	2	15 (2.6)	226 (63.1)	408 (66.6)	183 (21.6)	3.3 (1.1)	32.1 (5.0)	65.2 (3.7)
Poultry††	4	56 (9.8)	429 (190.0)	479 (35.2)	127 (51.1)	8.0 (5.1)	39.3 (7.6)	52.1 (12.7)
Goat††	1	9 (1.6)	291	303	104	6.8	46.3	46.3
Liver††	1	2 (0.3)	217	359	165	7.5	31.9	58.7
Fish/seafood‡‡	5	69 (12.0)	219 (194.1)	251 (116.0)	164 (82.4)	14.8 (8.0)	30.7 (17.6)	53.7 (9.5)
Eggs††	2	88 (15.4)	220 (230.9)	279 (263.1)	143 (30.3)	7.2 (6.1)	24.7 (7.4)	67.9 (0.3)
Milk§§	3	17 (3.0)	228 (47.9)	119 (54.4)	51 (17.4)	35.9 (9.6)	19.1 (2.6)	45.1 (7.3)
Beans	2	102 (17.8)	129 (141.3)	238 (222.7)	226 (75.7)	17.9 (15.0)	12.9 (15.1)	67.5 (30.9)
Nuts¶¶	4	62 (10.8)	224 (290.5)	556 (328.0)	411 (215.7)	20.1 (17.2)	14.5 (4.0)	64.5 (13.8)
Cassava***	2	7 (1.2)	100 (0.0)	312 (225.1)	312 (225.1)	71.0 (36.4)	5.8 (5.6)	22.4 (29.9)
Vegetables (except leaves) †††	2	25 (4.4)	382 (365.3)	111 (66.5)	38 (18.8)	40.3 (19.7)	10.3 (2.7)	45.6 (22.0)
Leaves‡‡‡	4	16 (2.8)	371 (56.3)	977 (220.1)	263 (31.5)	10.9 (1.8)	13.3 (1.1)	72.8 (2.6)
Potatoes§§§	2	63 (11.0)	289 (13.2)	305 (122.6)	105 (37.6)	65.0 (22.7)	7.2 (3.7)	22.3 (29.9)
Fruit	25	204 (35.7)	155 (90.2)	128 (192.0)	78 (76.6)	86.5 (28.3)	5.7 (2.6)	12.4 (25.8)
Water and tea	2	172 (30.0)	-	0 (0.0)	0 (0.0)	-	-	-
<b>Processed culinary ingredients  </b>	<b>3</b>	<b>10 (1.2)</b>	<b>10 (0.0)</b>	<b>47 (23.6)</b>	<b>473 (236.5)</b>	<b>66.4 (57.2)</b>	<b>0.5 (0.3)</b>	<b>33.2 (57.6)</b>
Sugar	1	2 (20.0)	10	39	389	99.7	0.2	0.0
Butter	1	4 (40.0)	10	74	740	0.4	0.3	99.7
Honey	1	4 (40.0)	10	29	290	99.0	0.8	0.0

Processed foods	6	92 (11.4)	72 (67.3)	179 (165.7)	274 (109.9)	36.3 (37.5)	24.6 (16.7)	39.0 (28.5)
Sandwiches	1	58 (63.0)	165	336	204	59.2	18.4	20.0
Industrial bread	2	81 (88.0)	55 (63.6)	147 (150.6)	327 (103.9)	75.3 (7.5)	11.1 (1.5)	14.8 (10.9)
Canned fish	1	3 (3.3)	125	386	309	1.3	25.9	72.8
Processed meats	1	1 (1.1)	20	21	107	6.7	56.1	37.0
Cheese	1	11 (12.0)	10	37	374	0.2	25.1	74.6
Ultra-processed foods	31	479 (59.1)	151 (111.0)	266 (250.5)	255 (186.1)	50.6 (33.4)	5.7 (6.3)	24.1 (23.2)
Sweet bread	1	4 (0.8)	50	171	341	63.3	11.7	23.8
Fast-food dishes	4	30 (6.3)	239 (97.1)	546 (206.0)	234 (49.7)	33.6 (8.7)	17.3 (2.7)	47.2 (10.1)
Cakes and cookies	3	302 (63.0)	110 (74.7)	513 (348.6)	466 (24.8)	53.0 (8.3)	5.3 (0.6)	40.8 (9.1)
Fried snacks¶¶¶	2	198 (41.3)	100 (84.9)	454 (540.0)	351 (241.1)	50.9 (14.5)	3.9 (0.7)	43.3 (15.3)
Confectionary****	4	274 (57.2)	77 (28.1)	326 (162.8)	419 (136.7)	57.4 (19.6)	3.7 (1.9)	38.8 (17.9)
Popcorn	1	3 (0.6)	100	522	522	48.3	4.3	44.8
Sausages	2	48 (10.0)	28 (17.7)	93 (1.4)	423 (265.2)	4.8 (2.9)	14.3 (8.6)	41.0 (45.0)
Sugar-sweetened beverages	4	252 (52.6)	209 (115.6)	104 (34.4)	61 (26.6)	98.6 (3.2)	0.1 (0.2)	0.1 (0.2)
Sugar-free sweetened beverages	2	11 (2.3)	290 (56.6)	5 (6.6)	2 (2.7)	100.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Alcoholic beverages	6	31 (6.5)	165 (134.3)	117 (31.4)	137 (104.1)	28.2 (33.4)	1.5 (2.1)	0.1 (0.2)
Milk products††††	2	21 (4.4)	135 (162.6)	151 (122.0)	210 (162.6)	70.3 (1.9)	7.8 (1.0)	21.0 (1.6)

SF, street-food; SD, standard deviation.

\*N refers to the number of different dishes that were included in each category; †For beverages, quantities are expressed in volume (mL); ‡For food products sold loose (candies, nuts, biscuits, etc.), we considered a serving size of 100g; §In case of foods with more than one sample; ||The sum of the values within each of the main categories is higher than N because of multiple choice answers; ¶Includes popcorn, *massaroca* (grilled corn cob) and *xima* (side dish made with corn flour and water); \*\*Includes pasta, handmade cakes and biscuits; ††Includes different types of culinary preparations; ‡‡Includes fish samosas, fried fish and stewed squid; §§Includes fresh milk, powdered milk and tea with milk; ||||Includes stewed beans and *badjias* (fried dumplings made with beans, onion and garlic); ¶¶Includes peanuts, cashews and peanut curry; \*\*\*Includes raw cassava and *lifete/molina* (sweet made with cassava flour, roasted peanuts and sugar); †††Includes soup and salad; ‡‡‡Includes *matapa*, *cacana* and *m'boa* (main courses made with coconut, peanuts and leaves); §§§Includes regular and sweet potato; |||||Includes pizza, hot-dogs and hamburgers; ¶¶¶Includes chips and pre-fried samosas; \*\*\*\*Includes candies, chocolates and ice-cream; ††††Includes flavoured/sweetened yogurt and condensed milk.

## 6. Collaboration in a scoping review of internationally published articles about street food

Street foods vary widely, regarding nutritional composition and safety characteristics, contributing for a sizable proportion of food intake in many populations worldwide. In this context, this study aimed to describe the coverage by the scientific literature of different 55 health-related and socio-economic aspects of street food consumption and trading.

For the purpose of this work, only original research articles addressing street food published in scientific journals were included. Three electronic databases were searched, using the following search expression: (*"street-foods" OR "street food" OR "street food vending" OR "street vendor" OR "mobile food vendors" OR "street-vendor" OR "street food markets" OR "street market" OR "street markets"*). Hand-search of relevant journals and backward citation tracking were also used to identify eligible articles.

We selected articles whose main objectives or specific results were related with the assessment of different health-related and socio-economic aspects of street food consumption and trading. The papers assessed were published in English, Portuguese, French, Spanish or Italian. For papers published in other languages, the English abstract was assessed. Studies not providing original data (e.g. reviews, opinion papers), conference proceedings, Master theses and study protocols were excluded.

Independent evaluation of the selected articles was conducted by two reviewers, which extracted the following information: name of first author; year of publication; country of origin of the study; aim of the study and main street food-related topics addressed; definition of street food; target population; study design; sample size. Time trends and geographical distribution of publications of street food-related articles was presented. According to the topics addressed, the selected articles were classified into six main categories, namely food, vendors, consumers, vending places, interventions and miscellaneous, which were further divided in a total of 18 sub-categories (**Table 3**).

A total of 345 articles were selected, which were conducted in 64 countries. An increase in the number of articles published over the last three decades was observed (**Figure 9**). Nearly half of the selected papers were published in the past five years, and nearly two-thirds were published since 2005. A total of 71.4% of the studies were from Africa or Asia (**Figure 10**). The articles addressed a large number of different topics, mostly related with food safety (88.9%) and availability/consumption of street food (29.7%). As shown in **Figure 11**, the proportions of papers classified in each of the main categories according to

the topics covered, in descending order, were as follows: “food” (64.9%), “vendors” (32.5%), “consumers” (25.8%), “vending places” (15.9%), “intervention” (1.2%), and “miscellaneous” (3.8%).

**Table 3** - Street food-related topics addressed in the papers selected for the scoping review, 308 by main categories and sub-categories.

Main category	Sub-category	Topics addressed in the original reports
Food	-Microbiological contamination	-Bacteriological, fungal, viral, parasitological contamination
	-Physical and chemical contamination	-Contamination with adulterants, heavy metal, other chemicals (e.g.: aflatoxins, mycotoxins), foreign particles, coloring agents, mutagens
	-Food availability or nutritional characteristics	-Types of street food sampled or listed out, degree of processing, nutritional composition, proximate composition
	-Sensory properties	-Sensory characteristics
Vendors	-Health status	-Medical check-ups, health condition
	-Personal hygiene	-Hand washing; protective clothing (e.g.: head covering); avoiding wearing jewelry, watches, pins or other items; isolation of cuts and wounds; avoid smoking and other behaviors (e.g.: spitting, chewing or eating, sneezing, coughing)
	-Food handling	-Preparation and cooking practices, raw material procurement practice, serving practice, methods used for cleaning, leftover management, waste disposal practice, sanitary and hygienic practices, hazard analysis and critical control points
	-Knowledge, awareness and perception	-Knowledge, awareness and perception on personal hygiene, food handling practices, contamination, food borne diseases, importance of street food and training
	-Characterization	-Geographical location and assessment of vendors
Consumers	-Consumption pattern	-Contribution to energy or nutrient intake, frequency of consumption, reasons for purchasing, buying, consuming, preference of consumption, reasons for consumption, expenditure and spending, street food consumption history
	-Attitudes, perception, awareness, satisfaction	-Attitudes, perception towards street food; perceived risk/benefit towards food safety
	-Acute diseases and outbreaks	-Acute diseases and outbreaks associated with consumption of street food
	-Chronic diseases	-Chronic diseases associated with frequent consumption of street food
Vending places	-Hygiene	-Hygiene of premises, equipment, utensils; microbial contamination of utensils, equipment, washing water, vending surfaces, cleaning clothes; presence of waste, flies, pests, insects, pets, toilet, dust
	-Location and typology	-Type of vending (e.g.: stationary, mobile), geographical location/neighborhood characteristics
Interventions	-Hygienic practices	-Training to improve handling practices, reduce microbial contamination and hygienic practices
	-Healthy food purchase	-Healthy food purchasing behavior of consumers
Miscellaneous	-Miscellaneous studies	-Microbial contamination of paper currency from street vendors, street food business, inspection of vending sites, quality of frying oil used by street food vendors, alternative food sources



Figure 9 - Number of articles addressed by publication year.

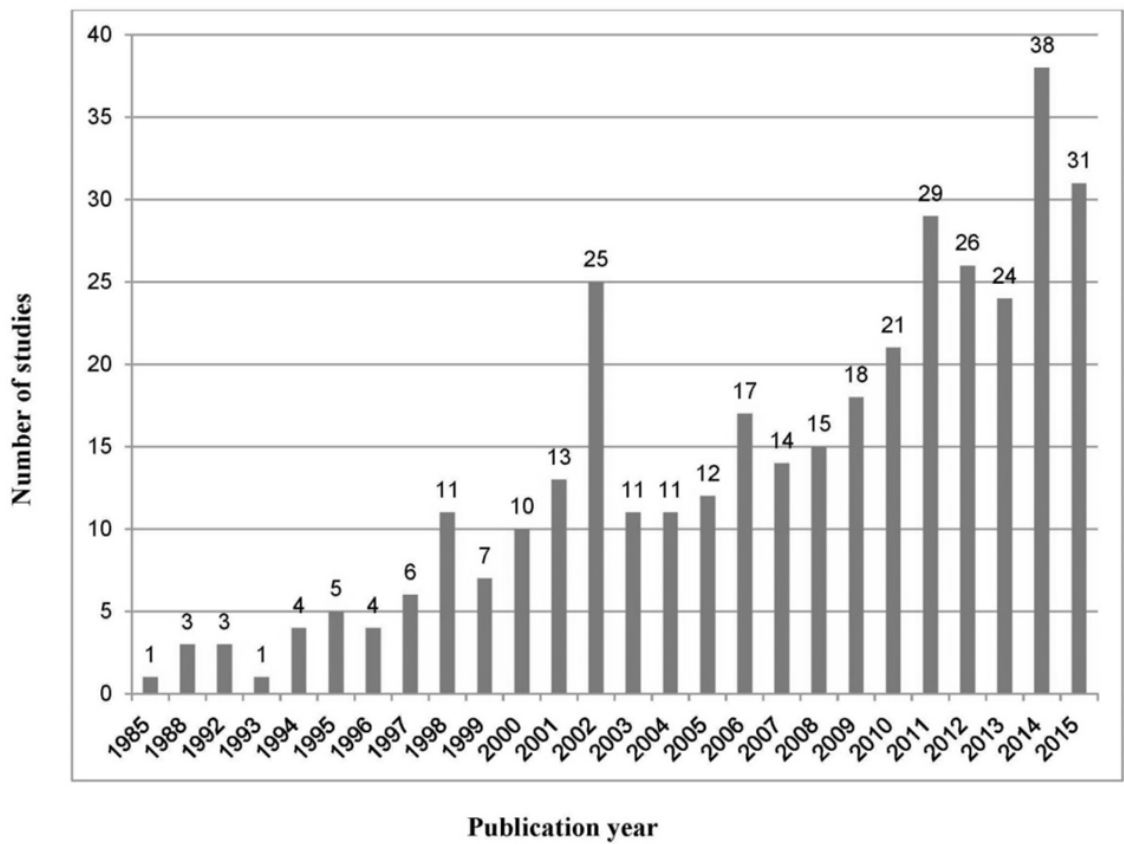
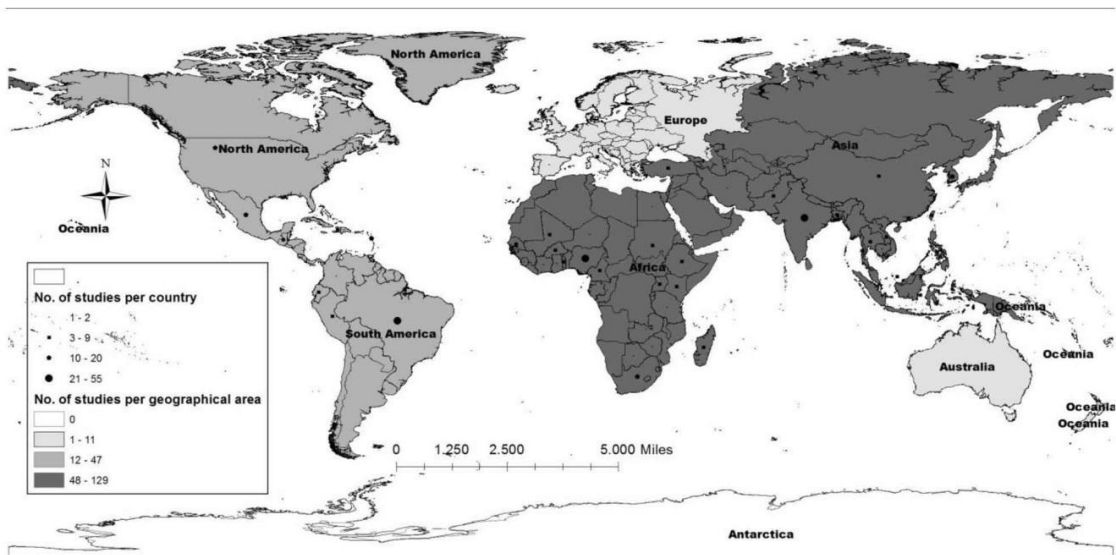
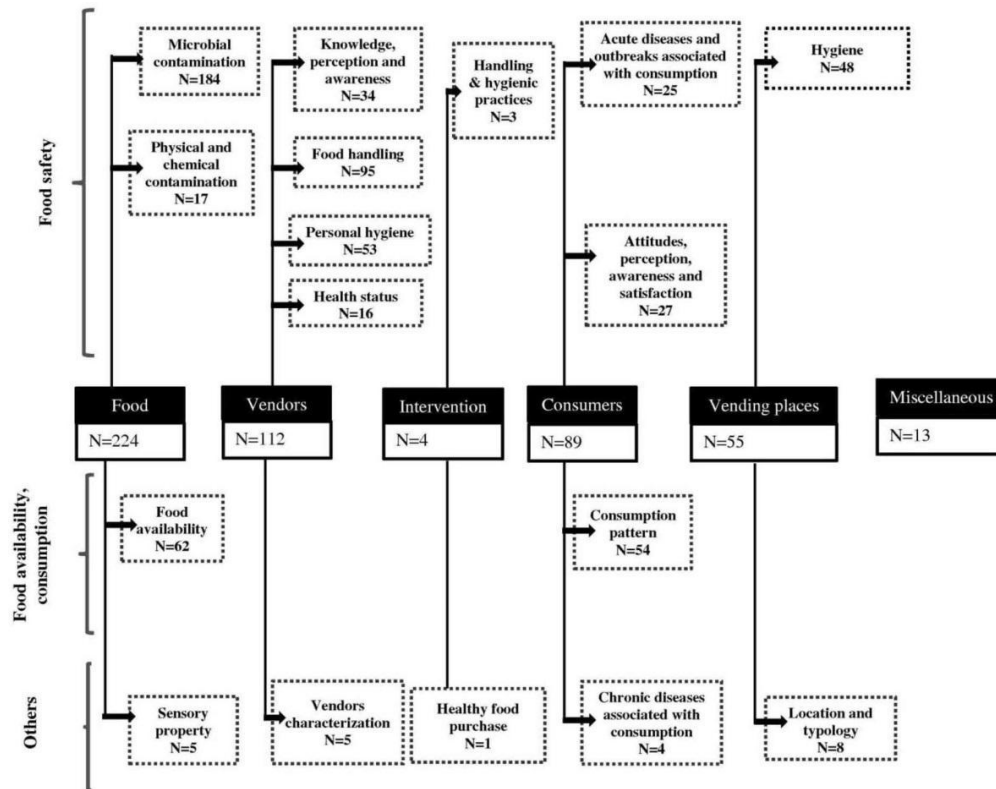


Figure 10 - Geographical distribution of articles addressing street food.



**Figure 11** - Street food-related topics addressed in the papers selected for the scoping review (N=345\*), by main categories (black background) and sub-categories (white background, dotted line), according to the subject covered (food safety, food availability/consumption, others).



\*The total number of papers by category may be less than the sum of the corresponding sub-categories because one article can be grouped more than once due to the number of topics addressed by each paper.

## 7. General conclusions

The results from this thesis show that street food offer in the urban areas of Mozambique is gradually approaching to the western food consumption pattern.

The presented article shows a high diversity of food products sold in street food vending sites, comprising homemade traditional dishes, fruit, nuts, soft drinks, alcoholic beverages, fried snacks and fast-food, among others. This was reflected in a high variability regarding nutritional composition, showing a great potential for strategies of promotion of healthier choices especially relevant for frequent street food consumers.

The coexistence of highly processed industrialized food products with natural foods and homemade dishes is observable, constituting an important trace of the nutrition transition phenomenon occurring in the urban areas of Mozambique.

The most frequently available foods other than fruit fell within the category of industrial, raising concerns about the potential impacts of frequent consumption of street food on health.

Regarding homemade food, there was a predominance of homemade cooked food in both mobile and stationary street food vending sites; however, almost all samples from bromatological analysis presented excess amounts of sodium, which can be explained by the frequent use of processed ingredients, mainly chicken powdered stocks, in most culinary preparations, as observed *in loco*. Bromatological analysis also showed on average a predominance of carbohydrates and fats compared to proteins.

This reinforces the urgent need for a thorough research on street food consumption patterns, degree of food processing and nutritional value in urban areas of developing countries.

According to the preliminary results of the essay presented, *in natura* or minimally processed foods were the most frequently available in street food vending sites, followed by ultra-processed foods.

The significant offer of both ultra-processed foods and *in natura* or minimally processed foods presented by the street food vending sites analysed supports the assumption that the Mozambican population is gradually approaching to the food habits of the western societies. Given the growing importance of street food regarding daily food intake in developing countries, a more comprehensive assessment of street food nutritional value, consumption patterns and health impact is needed.

Results from the scoping review of internationally published articles about street food shows an increase in the number of publications addressing street food in recent years, reflecting the growing importance of this topic within the scientific community. Street food arises as a broad subject matter when it comes to scientific literature, since it comprises a wide range of subtopics, such as microbiological and chemical contamination of food, food offer, health status and personal hygiene of street food vendors, consumption patterns, consumers' attitudes and perception towards street food, typology of vending places, among many others.

It was observable that a large percentage of studies is approaching matters of food safety related to street food, along with a scarcity of studies referring to street food availability, nutritional value and consumption patterns, reflecting a higher concern regarding immediate consequences rather than longer term effects of the consumption of street food. Studies on the nutritional composition and consumption of street food are needed in order to fulfil this research gap.

Regarding location, a significant number of studies were conducted in developing countries, reflecting the relevance of street food in those settings and the existence of major concerns regarding risk of food poisoning from street food in developing regions.

The main conclusions of this thesis are the following:

- In Maputo, there is a high diversity of foods and beverages sold in street food vending sites, with a coexistence of highly processed industrialized food products with natural foods and homemade dishes;
- The street foods analysed presented excess amounts of sodium and an average predominance of carbohydrates and fats over proteins;
- *In natura* or minimally processed foods were the most frequently available in the street food vending sites identified, followed by ultra-processed foods;
- Energy content per 100g of ultra-processed foods was significantly higher than *in natura* or minimally processed foods;
- Ultra-processed foods presented a predominance of carbohydrates and lipids, whereas the percentage contribution to total energy of proteins was higher in homemade dishes;
- A recent increase in the number of publications addressing street food is observable, with the majority of studies approaching matters of food safety and being conducted in developing countries.

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